

MCDOT GENERAL SPECIAL PROVISIONS

Instructions for use of these General Special Provisions (GSP's):

This set of GSP's contains certain sections that do not appear in the MCDOT Supplements (English and / or Metric) to the MAG Standard Specifications. The GSP's are to be used as a framework for developing project special provisions. Individual specifications herein are to be reviewed and modified as required by project specific conditions.

The table of contents and preceding each separate specification is an explanation of when the specification in general is applicable (Instruction on when a section should be used is indicated in parenthesis). Select the appropriate sections for inclusion in your project's Special Provisions, copy and paste into your document, and modify to English or Metric as needed for your project. This document shows both units rather than maintaining separate GSP's.

Changes to the current MCDOT Supplements to the MAG Standard Specifications are added periodically to these GSP's for immediate implementation. These revisions are to be added to project special provisions when the project is to be advertised prior to the effective date of the next MCDOT Supplement. The changes are not to be added to project special provisions when the construction advertisement date is to occur after the anticipated publication date of the next MCDOT Supplement. The MCDOT Supplement is published annually to be effective July 1.

Individuals preparing Special Provisions should be familiar with MCDOT Engineering Division's ***A Guide For The Preparation Of Contract Specifications***, revised April 2000.

Coordinate revisions and additions to these GSP's with Robert Herz.
(Phone: 602-506-4760, email: rherz@mail.maricopa.gov)

GSP 2004 CONTENTS

• Location (All Projects – fill-in).....	6
• Proposed Work (All Projects – fill-in)	6
• Contract Time (All Projects – fill-in).....	6
• Available Informational Material: (Include when a soil boring report, cross sections or other material is available. Revise listing to accurately describe the available items. Revised 06/07/2004).....	6
• Section 104.4 Partnering (Requested by Operations Div., Construction Admin. (5/11/99) to be included in all projects over \$750,000 construction estimate – Allowance is not to exceed \$5,000. Revised 7/10/00).....	6
• Section 105.6 Cooperation with Utilities (Use for All Projects – fill-in).....	7
• Section 107.2 Permits (Include when permits are required from entities other than MCDOT. Revised 11/05/01).....	7
• Section 107.2.1 (Include if project <u>is</u> subject to AZPDES requirements. Use for all projects that may cause disturbance of one or more acres of land during construction. Revised 4/10/03).....	8
• Section 107.2.1 (Include if project <u>is not</u> subject to AZPDES requirements. Revised 4/10/03).....	8
• Section 107.2.2 Environmental Mitigation Measures (Include on all PM 10 projects and other Federal Aid projects unless otherwise directed. Add to the bidding schedule item 107.02100 Environmental Mitigation Compliance. Added September 12, 2002).....	8
• Section 107.2.2 Corps of Engineers Section 404 Permit (Include if project is subject to 404 Permit requirements. Add to the bidding schedule item 107.02200 404 Permit Compliance. Revised Jan 23, 2002)	9
• Section 107.15 Community Relations (Include when directed. Use when a separate community relations contract is issued. Include COMMUNITY RELATIONS SUPPORT as a pay item and verify the allowance amount (\$6,000 is the usual recommended amount) for the construction Bidding Schedule. Revised 6/27/2004).....	10
• Section 111 Engineer’s Office Facilities (Include if Type II Engineer’s Office Facilities <u>is not</u> required. <u>Choose appropriate sentence</u> . Revised June 29, 2001)	11
• Section 201 Clearing and Grubbing (Include on PM-10 Projects to limit the amount of disturbed area. Revised March 14, 2002)	11
• Section 210 Borrow Excavation (Include for borrow projects when the pavement structural section is designed for a lower quality soil. This change must be approved by the MCDOT Materials Section. Added August 7, 2002)	12
• Section 210 Borrow Excavation (Include for borrow projects when a specific borrow site is NOT designated for project use. Revised October 9, 2002)	12

- Section 211 Fill Construction (Include for borrow projects when a specific borrow site is NOT designated for project use. Revised August 12, 2002)12
- Section 210 Borrow Excavation (Include when a specific borrow site is designated for project use and no other borrow sources will be used. Revised August 6, 2002)13
- Section 211 Fill Construction (Include when fill material is to be generated from a designated borrow site or from channel excavation. Delete sections such as “Borrow Excavation” when it does not apply. Revised Aug 6, 2002).13
- Section 221 Gabion Construction (Include when gabion construction is required. Revised Aug 6, 2002)13
- Section 223 Reinforced Slope Construction (Consider using a modification of this specification when reinforced slope construction is required. Revised April 19, 2001)18
- Section 301 Subgrade Preparation (Include on PM-10 projects that have pay items for earthwork and use soil cement base or lime slurry stabilization. Added October 10, 2002).....23
- Section 302 Subgrade Preparation (This is a fill-in specification to be used for a stabilized penetrate and chip seal. Revised April 1, 1999).....23
- Section 303 Grade and Shape Subgrade (Include on PM-10 projects that have small amounts of earthwork and use soil cement base or lime slurry stabilization. Revised 11/15/2004)26
- Section 311 Soil Cement Base Course (Include on PM-10 Projects using soil cement base course. Revised July 31, 2002)26
- Section 312 Cement Treated Base (Include when it is necessary to include the cement content by weight. Revised April 1, 1999)27
- Section 315 Bituminous Prime Coat (Include if a bituminous prime coat may be required. Revised May 6, 2002)28
- Section 321 Asphalt Concrete Pavement (Include on projects when the plans do not identify the pavement mix design method to be used. Delete the mix design method not being used. When Superpave is used indicate Low or Heavy traffic. Revised February 25, 2004)28
- Section 321 Asphalt Concrete Pavement (Include on projects with new asphalt pavement length greater than 0.5 miles (800 m) and a functional classification of collector or higher. The project must have a minimum of two (2) courses of Hot Mix Asphalt in which the compacted depth of each layer is 1.0 inch (25 mm) or greater and/or overlay with a minimum thickness of 1.5 inches (40mm). To insure proper project funding include the pay item Rideability with an Allowance estimated at 10% of the surfacing course costs. Revised 3/15/2004).....28
- Section 322 Asphalt Concrete Overlay (Include on projects with an asphalt pavement overlay extending greater than 0.5 miles (800 m) in length, has a functional classification of collector or higher, and the overlay compacted depth is a minimum of 1.5 inches (40mm). Also insert Section 321.6.7 of these General Special Provisions. Revised 3/15/2004)31
- Section 325 Asphalt-Rubber Concrete, Gap Graded (Include with projects that use asphalt-rubber concrete and the plans have not designated the

traffic parameter “Heavy Traffic” or “Low Traffic” for mix design. Added November 5, 2003).....	32
• Section 325 Asphalt-Rubber Concrete, Gap Graded (Include on projects with an asphalt rubber pavement surface course extending greater than 0.5 miles (800 m) in length, a future functional classification of collector or higher, and the asphalt-rubber concrete surface course compacted depth is a minimum of 1.5 inches (40mm). Also insert Section 321.6.7 of these General Special Provisions. Revised 3/15/2004).....	32
• Section 330 Asphalt Chip Seal (Include in projects requiring a two day waiting period between placement of the prime coat and chip seal coat. Revised April 1, 1999)	32
• Section 330 Asphalt Chip Seal (Include in projects requiring a double chip seal. For PM-10 projects using soil cement base course, include the special provision for Section 311 and include the PM-10 Structural Section Detail in the construction plans. Revised 11/18/2004)	33
• Section 337 Price Adjustment for Bituminous Materials (Include in projects when asphalt prices may significantly fluctuate between the bid date and date of actual use. Requires identification of effected bid items. To insure proper project funding include the pay item 337.01000 Price Adjustment for Bituminous Materials with an Allowance to fund a 25% cost increase for bituminous materials. Revised 5/17/2004).....	40
• Section 401 Traffic Control (Include in projects only when a Portable Radar Speed Display System is specifically requested. Revised October 22, 2001)..	43
• Section 415, Flexible Metal Guardrail (Include in projects that require reconstruction of existing guardrail or construction of guardrail from salvaged material. Revised June 1, 2000)	44
• Section 420 Chain Link Fence (Include in projects with a bid item for Chain Link Bridge Fence – PER ADOT STD. DWG. B-22.50, 22.60, AND 22.70. Revised June 1, 2000)	46
• Section 430.5.8 Native Hydro Seeding (Include on all PM 10 projects that require seeding of disturbed areas. Add to the bidding schedule item 430.01201 Native Hydro Seeding with the units of Acres (Ha). Added October 7, 2002).....	47
• Sections 465.4 and 465.5 Measurement and Payment (Include on projects that install non-illuminated Metro Street Name Signs and the project is to be advertised prior to July 2005. This revision will be added to the 2005 MCDOT Supplement to MAG. Added 11/3/2004)	48
• Section 470.4.1 Quality Requirements (Include on projects that install signal facilities and the project is to be advertised prior to July 2005. This revision will be added to the 2005 MCDOT Supplement to MAG. Added 7/26/2004)	49
• Section 481.3.1(A) General Requirements (Include on projects that install fiber optic conduits and the project is to be advertised prior to July 2005. This revision will be added to the 2005 MCDOT Supplement to MAG. Added 7/14/2004)	49

• Section 505.11 Measurement (Include in projects when payment for reinforced concrete box culverts is based on quantities of Concrete and Reinforcing steel. Added August 8, 2002).....	50
• Section 505.6.4 Longitudinal Joints between Precast Bridge Deck Members (Include in projects with longitudinal joints between precast bridge deck members. This section is to be used with section 506.9.1.).....	50
• Section 506.9.1 Longitudinal Joints between Precast Bridge Deck Members (Include in projects with longitudinal joints between precast bridge deck members. This section is to be used with section 505.6.4.).....	50
• Section 508, Cattle Guard (Include in projects with cattle guard installations. Revised 12/18/2003).....	53
• Section 516, Irrigation and Drainage Grates (Include in projects with Irrigation or Drainage Gates, the specific gate requirements are to be inserted. Revised July 11, 2001).....	54
• Section 523 Headwall (Include in projects with a bid item for headwall. Revised January 24, 2003).....	54
• Section 525 Pneumatically Placed Mortar (Include in projects with a bid item for pneumatically placed mortar used for canal lining. Adjust lining structural section when appropriate. Revised November 5, 2001)	55
• Section 530, Painting (Include when the project includes a bid item for concrete painting. Revised April 1, 1999).....	55
• Section 610 Waterline Construction (Include in projects when ductile iron pipe is required. This GSP requires review and modification prior to use. Revised April 1, 1999)	56
• Section 615 Sewer Line Construction (Include in projects requiring ductile iron pipe for sewer line construction. Revised April 1, 1999).....	57
• Section 622 Pipe Culvert (Include when pipe culvert material is to be determined by the contractor. The Contractor may choose to use reinforced concrete, HDPE pipe, or corrugated metal pipe. Revised March 13, 2002)	58
• Section 624 Temporary Pipe Culvert Installation (Use when pipe culverts are required for a designed detour. Allows contractor to provide alternative pipe material and sizes, to obtain a minimum hydraulic capacity. The Contractor may choose to use reinforced concrete, HDPE pipe, or corrugated metal pipe. The plans should identify the installation as TEMPORARY PIPE CULVERT, give the hydraulic parameters and an acceptable alternative. Revised November 7, 2001).....	58
• Section 625 Manhole Construction And Drop Sewer Connections (Use when Pollutant Separator Vaults are part of the storm drain system and detailed in the project plans. Revised July 31, 2001)	59
• Section 626 Miscellaneous Structures (Roadway Drainage And Irrigation) (Include in projects only if directed. This is a draft specification to allow all minor and miscellaneous concrete structures to be precast and the specification will need substantial modification. Revised June 1, 2000)	60
• Section 636 Concrete Canal Lining (Include in projects with concrete lined canals use section 635 for smaller irrigation ditches.	61

**Location (All Projects – fill-in)
(April 1, 1999)**

LOCATION OF THE WORK: This project is located: _____ Arizona
(Maricopa County).

Proposed Work (All Projects – fill-in)

PROPOSED WORK: The work consists of

**Contract Time (All Projects – fill-in)
(May 17, 2004)**

CONTRACT TIME: The Contractor shall complete all project work within ____ calendar days beginning with the start date specified in the Notice to Proceed.

Available Informational Material: (Include when a soil boring report, cross sections or other material is available. Revise listing to accurately describe the available items. Revised 06/07/2004)

AVAILABLE INFORMATIONAL MATERIAL: The following information is available for inspection or purchase at the Customer Service Desk of Maricopa County Department of Transportation, 2901 West Durango Street, Phoenix, Arizona. Purchases must be with cash or check, credit cards are not accepted.

- Soil Boring Report
- Roadway Cross Sections
- Channel Cross Sections

Section 104.4 Partnering (Requested by Operations Div., Construction Admin. (5/11/99) to be included in all projects over \$750,000 construction estimate – Allowance is not to exceed \$5,000. Revised 7/10/00)

104 SCOPE OF WORK add the following:

104.4 PARTNERING:

The County intends to encourage the foundation of a cohesive partnership with the Contractor and its principal subcontractors and suppliers. This partnership will be structured to draw on the strengths of each organization to identify and achieve reciprocal goals. The objectives are effective and efficient contract performance and completion within budget, on schedule, and in accordance with plans and specifications.

To implement this partner initiative, prior to starting of work and prior to the pre-construction conference, Contractor's management personnel and the County, through

its authorized representatives, will initiate a partnering development seminar/team building workshop. Project personnel will make arrangements to determine attendees at the workshop, agenda of the workshop, duration, and location. Persons required to be in attendance will be the Engineer and key project personnel; the contractor's on-site project manager, and key project supervision personnel of both the prime and principal subcontractors and suppliers. The design engineers, FHWA, and key local government personnel will also be invited to attend as necessary.

Follow-up workshops may be held periodically throughout the duration of the contract as agreed by the Contractor and the County.

The establishment of a partnership charter on a project will not change the legal relationship of the parties to the contract, nor relieve either party from any terms of the contract.

The County will reimburse the Contractor, based upon approved invoices and documented expenses such as taxes or bond cost charges to Contractor in connection with the Item PARTNERING, an amount not to exceed the ALLOWANCE shown in the Bidding Schedule. Expenses eligible for reimbursement are direct expenses incurred in providing facilities, facilitators, supplies, and materials for the seminar/team building workshops. No labor costs or additional mark-up for profit and/or fee for Contractor will be eligible for reimbursement.

**Section 105.6 Cooperation with Utilities (Use for All Projects – fill-in)
(April 1, 1999)**

SECTION 105 CONTROL OF WORK

105.6 COOPERATION WITH UTILITIES:

The following utilities are expected to be located within the limits of this project. These utilities, along with the contact information, are listed below:

(Add Utility name, contact name and phone number here. When type of utility is not clear, state the type of facilities owned.)

Section 107.2 Permits (Include when permits are required from entities other than MCDOT. Revised 11/05/01)

107 LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC

107.2 PERMITS

Section 107.2 add the following:

(Provide information to Bidders concerning permit requirements for partnering towns, cities, ADOT, or other permitting entities. List the agency, agency contact and project specific permit requirements including permit fees that are required based on prior coordination. If MCDOT has obtained the permit, indicate that MCDOT has obtained the permit and provide a copy of the permit in the Contract Bid Documents.)

Section 107.2.1 (Include if project is subject to AZPDES requirements. Use for all projects that may cause disturbance of one or more acres of land during construction. Revised 4/10/03)

107.2.1 AZPDES (NPDES) Construction General Permit Requirements:

This project is subject to the Arizona Pollutant Discharge Elimination System (AZPDES) general permit requirements for construction sites under the Arizona Department of Environmental Quality (ADEQ), the AZPDES Construction General Permit.

Section 107.2.1 (Include if project is not subject to AZPDES requirements. Revised 4/10/03)

107.2.1 AZPDES (NPDES) Construction General Permit Requirements:

This project is not subject to the Arizona Pollutant Discharge Elimination System (AZPDES) general permit requirements for construction sites under the Arizona Department of Environmental Quality (ADEQ), the AZPDES Construction General Permit.

Section 107.2.2 Environmental Mitigation Measures (Include on all PM 10 projects and other Federal Aid projects unless otherwise directed. Add to the bidding schedule item 107.02100 Environmental Mitigation Compliance. Added September 12, 2002)

Section 107.2 PERMITS add the following new section:

107.2.2 Environmental Mitigation Measures

The Contractor shall adhere to all terms and conditions, and requirements contained in the Memorandum issued by the Arizona Department of Transportation's Environmental Planning Group. Documents related to the Environmental Mitigation Measures are located in an Appendix to these Special Provisions.

During project construction, MCDOT Environmental Planning Section shall be notified at (602) 506-8068/6798 of any proposed changes in scope of work and/or work to be added outside the defined project limits, for evaluation of potential environmental impacts.

Payment for Environmental Mitigation Compliance will be made at the Contract Lump Sum Price. Payment shall be full compensation for performing all activities associated with fulfilling the environmental mitigation measures that are not directly included within other pay items. Contractor will be compensated for this bid item at a rate of 15% of the lump sum bid with the first progress payment. The remaining 85% of the bid amount will be pro-rated over the entire length of the project.

[Include all Memorandum Related Documents within an appendix of the Contract Documents/Special Provisions.]

Section 107.2.2 Corps of Engineers Section 404 Permit (Include if project is subject to 404 Permit requirements. Add to the bidding schedule item 107.02200 404 Permit Compliance. Revised Jan 23, 2002)

Section 107.2 PERMITS is modified to add the following new section:

107.2.2 CORPS OF ENGINEERS SECTION 404 PERMIT

The Contractor shall adhere to all Permit terms and conditions, including 401 Certification conditions issued by the Arizona Department of Environmental Quality. The Contractor shall prepare draft copies of all required correspondence and electronically forward them to the Engineer for review and signature; the Contractor will be provided copies of all signed Permit correspondence.

Include the following paragraph only when the 404 Permit requires marking or staking of the 404 permitted work area. [MCDOT will provide initial staking of the boundaries of the 404 permitted work area. The Contractor shall protect, maintain, and augment the boundary markers as needed to insure that the boundary is clearly marked for the duration of the project.]

During project construction, MCDOT Environmental Planning Section shall be notified at (602) 506-8068/6798 of any proposed changes in scope of work and/or work to be added outside the defined project limits, for evaluation of potential environmental impacts.

Payment for 404 Permit Compliance will be made at the Contract Lump Sum Price. Payment shall be full compensation for performing all activities associated with fulfilling 404 Permit Compliance that are not directly included within other pay items. Contractor will be compensated for this bid item at a rate of 15% of the lump sum bid with the first progress payment. The remaining 85% of the bid amount will be pro-rated over the entire length of the project.

Documents related to the Section 404 Permit are located in an Appendix to these Special Provisions.

[Include all 404 Related Documents within an appendix of the Contract Documents/Special Provisions.]

Section 107.15 Community Relations (Include when directed. Use when a separate community relations contract is issued. Include COMMUNITY RELATIONS SUPPORT as a pay item and verify the allowance amount (\$6,000 is the usual recommended amount) for the construction Bidding Schedule. Revised 6/27/2004)

Additional instructions: Determine with MCDOT Community Relations if documentation of existing conditions is to be the Construction Contractor's responsibility. When documentation of existing conditions is the Construction Contractor's requirement, use the red text changes (change to black), otherwise delete.

107.15 COMMUNITY RELATIONS:

Section 107.15 is revised to read:

107.15.1 General: Contractor shall provide assistance for this project's community relations program. The program assistance shall include, but not necessarily be limited to:

- (A)** Participate in public meetings as required by the Engineer.
- (B)** Provide informational signage.
- (C)** Document existing property conditions prior to starting construction.

Contractor shall assist the County's public information program by providing information needed to inform the local residents and businesses of necessary operations which create high noise levels, street closures, detour locations, haul routes and material delivery routes, hours of construction, and disruption of bus routes and other delivery/pick-up routes. Contractor shall assist the Engineer in responding to questions or complaints concerning construction operations or procedures.

107.15.2 Meetings: Contractor shall attend and participate in public meetings deemed necessary by the Engineer. Meeting times, locations, and agenda will be determined by the Engineer with the assistance of the County's community relations' staff. Contractor may be required to attend a public pre-construction meeting at a location convenient to residents and business operators affected by the project. This meeting may be conducted after execution of contract documents and prior to the start of construction. The meeting if conducted prior to the Notice to Proceed shall not be included in the Contract Time.

107.15.3 Informational Signage: Contractor shall provide and install advance information signs and project information signs. Advanced Project Notification Signing shall be installed at least 14 days before beginning construction to inform the public of the forthcoming project, construction dates, and suggested alternate routes. Sign layout

examples are available from the Engineer. Signs shall not be constructed or installed prior to approval by the Engineer of the designs, sizes and proposed locations. Contractor shall maintain the signs as necessary and update the information as requested by the Engineer. Advance information signs and project information signs are not part of Section 401 Traffic Control but their location shall be shown in the Traffic Control Plan.

107.15.4 Existing Conditions Documentation: Contractor shall document existing property conditions within a 100-foot (minimum) radius of the project limits prior to construction. Documentation shall be video recorded tape supplemented with 35 mm photographs. The videotape shall not be made from a moving vehicle. One (1) copy of the documentation package shall be provided to the Engineer within ten (10) calendar days of the Notice to Proceed date.

107.15.4 (107.15.5) Payment: The County will pay, based upon approved time and material invoices, in accordance with Section 109.5 an amount not to exceed the ALLOWANCE shown in the Bidding Schedule under Item COMMUNITY RELATIONS SUPPORT, for authorized work performed in assisting with the County's public information program for this project.

Section 111 Engineer's Office Facilities (Include if Type II Engineer's Office Facilities is not required. Choose appropriate sentence. Revised June 29, 2001)

SECTION 111 ENGINEER'S OFFICE FACILITIES

111.1 DESCRIPTION:

Type I Engineer Office Facilities will be required for this project.

Engineer Office Facilities will not be required for this project.

Section 201 Clearing and Grubbing (Include on PM-10 Projects to limit the amount of disturbed area. Revised March 14, 2002)

SECTION 201 CLEARING AND GRUBBING

201.3 Construction Methods

Modify the first sentence by deleting the phrase "or to a line 3 m outside the edge of the surfaced area, whichever is greater,". The intent of this change is to minimize the amount of disturbed area.

Section 210 Borrow Excavation (Include for borrow projects when the pavement structural section is designed for a lower quality soil. This change must be approved by the MCDOT Materials Section. Added August 7, 2002)

SECTION 210 BORROW EXCAVATION

210.2 Imported Borrow

The allowable value of X in the equation $X = (\text{Minus } 200) + 2.83 (\text{PI})$ is revised to not exceed **62**. **[Replace the value of 62 with the revised allowable value based on pavement design parameters.]**

Section 210 Borrow Excavation (Include for borrow projects when a specific borrow site is NOT designated for project use. Revised October 9, 2002)

SECTION 210 BORROW EXCAVATION

210.4 Measurement

Quantities of borrow will NOT be measured.

210.5 Payment is revised by the following:

No separate payment will be made for Borrow Excavation. All required borrow shall be included in the price paid for Fill Construction.

Section 211 Fill Construction (Include for borrow projects when a specific borrow site is NOT designated for project use. Revised August 12, 2002)

SECTION 211 FILL CONSTRUCTION

211.5 Measurement add the following:

Fill Construction will be computed by the average end area method. Measurement will extend from the existing ground surface (at time of bid) to the in-place compacted roadway embankment surfaces constructed to the limits defined by the Project Plans or as directed by the Engineer. No adjustment to measured fill construction shall be made based on changes in the ground surface resulting from clearing and grubbing activities or ground compaction. All roadway embankment construction will be measured complete-in-place.

Section 211.6 Payment add the following:

Payment for Fill Construction shall include all costs associated with acquiring, hauling and placing embankment material. Roadway embankment includes acceptable materials obtained from roadway excavation, channel excavation (retention basins) and from borrow. No separate payment will be made for imported borrow.

Section 210 Borrow Excavation (Include when a specific borrow site is designated for project use and no other borrow sources will be used. Revised August 6, 2002)

210.4 MEASUREMENT

The first paragraph of Section 210.4 is revised to read:

Quantities will be computed by the average end area method.

Section 211 Fill Construction (Include when fill material is to be generated from a designated borrow site or from channel excavation. Delete sections such as "Borrow Excavation" when it does not apply. Revised Aug 6, 2002)

SECTION 211 FILL CONSTRUCTION

211.6 PAYMENT

Section 211.6 is revised to read:

Payment for all work under Section 211 Fill Construction will be made under Section 205 Roadway Excavation, Section 210 Borrow Excavation, or Section 215 Channel Excavation.

Section 221 Gabion Construction (Include when gabion construction is required. Revised Aug 6, 2002)

Part 200 add the following new Section:

SECTION 221 GABION CONSTRUCTION

221.1 DESCRIPTION

The work under this section shall consist of furnishing all materials, equipment, labor, and incidentals required to construct metallic-coated steel wire gabion mattresses at the locations and to the line and grade shown on the plans.

221.2 Materials

The material used for gabion fill shall be clean, hard, well-graded rock. The rock size for 300 mm (12") thick gabion mattresses shall be from 100 mm (4") to 200 mm (8") with

$D_{50} = 150 \text{ mm (6")}$. Placement of stone filling shall not exceed a 300 mm (12") vertical drop above the gabion mattress.

Rock shall be sound and durable, free from clay or shale seams, cracks or other structural defects. The bulk specific gravity (SSD) shall be determined in accordance with the requirements of AASHTO T-85 and shall be a minimum of 2.4. Rock may be rounded stones. Rock shall have a least dimension not less than one-third of its greatest dimension and a gradation in reasonable conformity with that shown herein. Control of the gradation will be by visual inspection.

The source and acceptability of the stone shall be submitted to the Engineer for approval. If testing is required, suitable sample of stone shall be taken in the presence of the Engineer at least 25 days in advance of the time when its use is expected to begin. The approval of a sample from a particular pit or quarry site shall not be construed as constituting the approval of all material taken from that site.

Gabion basket units shall be of non-raveling construction and fabricated from a double twist by twisting each pair of wires through three half turns developing the appearance of a triple twist per ASTM A975. The double twist mesh shall be manufactured from zinc-5% Al coated steel wire conforming to ASTM A856 Zinc-5% Aluminum-Mishmetal Alloy-Coated Carbon Steel Wire. The nominal diameter of the wire shall be 2.20 mm (0.0866 inches) for gabion mattresses and 3.05 mm (0.120 inches) for gabion baskets. The metallic-coated steel wire shall have a zinc-5% Al coating with at least 275 g/m² per DIN 1548, as manufactured by Maccaferri Gabions, Inc. (GalMac® wire) or approved equal. All gabion diaphragms and frame wires shall equal or exceed the requirements for Style 3 in ASTM A975. The mesh opening shall be hexagonal in shape and uniform in size measuring not more than 60 mm (2-½ inches) by 80 mm (3-¼ inches) for gabion mattresses. Selvedge or perimeter basket frame wire shall be of a heavier gauge than the mesh wire with a diameter of 3.80-mm (0.015 inches) after the zinc-5% Al coating. Lacing and connecting wire shall meet the same specifications as wire used in the gabion body except that its diameter shall be 2.31 mm (0.091 inches) (US gauge 13) after zinc-5% Al coating. The use of alternate wire fasteners shall be permitted in lieu of tie wire providing the alternate fastener produces a four (4) wire selvedge joint with a strength of 2,080 kg per lineal meter (1,400 lbs per linear foot) while remaining in a locked and closed condition. Properly formed interlocking fasteners shall be spaced from 100 mm to 150 mm (4 inches to 6 inches) and have a minimum 645 mm² (1 square inch) inside area to properly confine the required selvedge wires. The interlocking wire fastener shall meet material specification ASTM A-764, Finish 2, Class 1, Type 3. All of the above wire diameters are subject to tolerance limit of 0.100 mm (0.004 inches) in accordance with ASTM A641.

Bedding material shall be used under and behind the gabion baskets. Bedding material shall be clean and durable, and free from clay, shale, or organic material. Two layers of bedding material shall be used, Type I and Type II, conforming to the following gradations:

GRADATION FOR GRAVEL BEDDING

<u>Standard Sieve Size</u>	<u>Percent Passing by Weight</u>	
	<u>Type I</u>	<u>Type II</u>
3 inches (76 mm)	-	90 to 100
1-1/2 inches (38 mm)	-	-
3/4 inch (19 mm)	-	20 to 90
3/8 inch (9.5 mm)	100	-
#4 (4.75 mm)	95 to 100	0 to 20
#6 (1.18 mm)	45 to 80	-
#50 (0.30 mm)	10 to 30	-
#100 (0.15 mm)	2 to 10	-
#200 (0.075 mm)	0 to 2	0 to 3

A sample of each type of bedding material shall be provided to the Engineer for approval along with a sieve analysis of a representative sample of each type of bedding material.

The thickness of the gravel bedding shall be 100 mm (4 inches) for both Type I and Type II. Type II bedding shall be placed on top of Type I bedding.

Geotextile filter fabric shall be used behind and under the bedding material and shall be a non-woven fabric consisting only of long-chain polymeric filaments such as polypropylene or polyester formed into a stable network such that the filaments retain their relative position with each other. The fabric shall be inert to commonly encountered chemicals that adversely affect or alter its physical properties. The physical requirements for the geotextile fabric shall meet the following minimum average roll values:

<u>PROPERTY</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>
Grab tensile strength, kg (lbs)	91 (200)	ASTM D 4632
Grab elongation at break, %	45 min., 115 max	ASTM D 4632
Puncture strength, kg/mm ² (psi)	113,750 (80)	ASTM D 3787
Burst strength, kg (lbs)	215 (475)	ASTM D 3786
Trapezoidal tear strength, kg (lbs)	23 (50)	ASTM D 4533
Permittivity, cm/sec ⁻¹	0.48 maximum	ASTM D 4491
Apparent opening, US Std. sieve size	150-200	ASTM D 4751
UV stability, %	70	ASTM D 4355

Minimum average roll values represent the average test results for a lot in the weaker direction when sampled according to ASTM D 4354 and tested according to the test method specified above.

The identification, packaging, handling, and storage of the geotextile fabric shall be in accordance with ASTM D 4873. Fabric rolls shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure prior to placement.

Each roll shall be labeled or tagged to provide product identification sufficient to determine the product type, manufacturer, quantity, lot number, roll number, date of manufacture, shipping date, and the project number and name to which it is assigned. Rolls will be stored on the site or at another identified storage location in a manner that protects them from the elements. If stored outdoors, they shall be elevated and protected with a waterproof, light-colored, opaque cover. At no time shall the fabric be exposed to sunlight for a period exceeding 14 days.

221.3 Assembling and Placing

The gabion bed subgrade shall be excavated to the width, line, and grade shown on the plans. The gabions shall be founded on this bed and laid to the lines and dimensions required.

Excavation for toe or cut-off walls shall be made to the neat lines of the wall.

Gabions shall be fabricated in such a manner that the sides, ends, lid, and diaphragms can be assembled at the construction site into rectangular units of the specified sizes. Gabions are to be of single unit construction. The base, ends, and sides shall either be woven into a single unit or one edge, or shall be connected to the base section of the unit in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh.

Gabion mattress dimensions shall conform to sizes as follows:

<u>DIMENSIONS (m)</u>	<u>NO. CELLS</u>	<u>CAPACITY (m³)</u>
2 x 1 x 0.3	2	0.6
3 x 1 x 0.3	3	0.9
4 x 1 x 0.3	4	1.2

Tolerances: All gabion dimensions shall be within a tolerance limit of $\pm 5\%$ of the manufacturer's stated sizes.

The Contractor shall submit for review by the Engineer, shop drawings prepared by a Professional Engineer registered in the state of Arizona for the gabion layout at the locations shown in the plans. Said shop drawings will be based on the layout shown on the plans and shall include, but not be limited to plan and sections, basket sizes, and locations.

Where the length of gabion exceeds its horizontal width, the gabion is to be equally divided into cells by diaphragms of the same mesh and gauge as the body of the gabions. The length of the cells shall not exceed the horizontal width of the gabion. The gabion shall be furnished with the necessary diaphragms secured in proper position on the base section in such a manner that no additional tying at this juncture will be necessary.

All perimeter edges of gabions are to be securely selvedged or bound so that the joints formed by tying the selvedges have at least the same strength as the body of the mesh.

Gabions shall be placed to conform with the project plan details. Stone shall be placed in close contact in the unit so that maximum fill is obtained. The units may be filled by machine with sufficient handwork to accomplish requirements of this specification; however the stone filling shall not exceed a 300-mm (12-inch) vertical drop above the gabion basket. The exposed face or faces shall be hand-placed using stones to prevent bulging of the gabion cell and to improve appearance. Each gabion basket cell shall be filled in three lifts.

Two connecting tie wires shall be placed between each lift in each cell. Care shall be taken to protect the vertical panels and diaphragms from being bent during filling operations.

The last lift of stone in each cell shall be level with the top of the gabion in order to properly close the lid and provide an even surface for the next course.

All gabion units shall be tied together; each to its neighbor along all contacting edges in order to form a continuous connecting structure.

Empty gabions staked on filled gabions shall be laced to the filled gabion at the front, side, and back.

Filter fabric shall be placed in the manner and at the locations shown on the project plans. The surface to receive the fabric shall be free of obstructions, depressions, and debris. The filter fabric shall be loosely laid and not placed in a stretched condition.

The strips shall be placed to provide a minimum 600 mm (24-inch) overlap for each joint. On horizontal joints, the uphill strip shall overlap the downhill strip. On vertical joints, the upstream strip shall overlap the downstream strip.

The bedding material shall be carefully placed on the filter fabric in such a manner as not to damage the fabric. If, in the opinion, of the Engineer, the fabric is damaged or displaced to the extent that it cannot function as intended, the Contractor shall remove the bedding material, regrade the area if necessary, and replace the filter fabric.

221.4 Measurement

Gabion riprap shall be measured by the cubic meter (cubic yard) by computing the volume of the rock-filled wire baskets used.

221.5 Payment

The accepted quantities of gabion riprap, measured as provided above, will be paid for at the contract unit price bid, which price shall be full compensation for the work,

complete in place, including excavation, preparing the ground area and furnishing and installing the rock, bedding, fabric, and metal items, complete in place.

Section 223 Reinforced Slope Construction (Consider using a modification of this specification when reinforced slope construction is required. Revised April 19, 2001)

Part 200 add the following new Section:

SECTION 223 REINFORCED SLOPE CONSTRUCTION

The work under this section shall consist of designing, furnishing and installing geogrid reinforced embankment systems to the lines, and grades at the location(s) shown on the plans, as per manufacturer's recommendations or as requested by the Engineer. All fill material required for the reinforced slope or zone is included in this pay item.

223.1 SELECTION AND ACCEPTABILITY OF REINFORCEMENT SYSTEM:

The Contractor shall specify in the space provided on the Bidding Schedule what reinforcement system Contractor proposes to use for the construction of the reinforced slope. The apparent low bidder shall provide documentation of prior successful utilization of the selected system by 4:00 p.m. on the first Monday following bid opening as stated in section 223.3 of this specification. Failure to provide acceptable documentation shall be grounds for declaration of the bid as unresponsive and award of the contract to the next lowest responsive bidder. The Contractor shall not change reinforcement systems from that stated on the bidding schedule without written approval of the Engineer.

The Contractor shall furnish all materials, storage, handling, tools, equipment, labor, and any other appurtenances necessary to complete the work. The Contractor shall not begin placement of the geogrids until a qualified representative of the manufacturer is present at the beginning of the mesh placement.

The Contractor shall select the geogrid system and the installation method and determine the reinforcing spacing and embedment length subject to the review and approval by the Engineer. The Contractor shall be responsible for installing the mechanically stabilized sloped in accordance with this section and the manufacturer's recommendations.

The Contractor shall submit design calculations and cross-sections of his proposed mat layout, which shall be signed and stamped by a Civil Engineer registered in Arizona for approval. Test data shall be submitted to verify design parameters used in the design calculations. Said submittal shall be presented to the Engineer a minimum of 3 weeks prior to the slope construction. Construction shall not begin until the submittals have

been approved by the Engineer. Submittals shall be revised by the Contractor and resubmitted, as necessary.

The layout shall include mat widths, mat lengths, mat wastage, and mat orientation utilizing the mat types, spacing and total lengths required. The Contractor shall also detail the method he will utilize to place, spread, and compact the backfill and method deployed to hold mats securely in place during windy conditions.

223.2 DEFINITIONS:

(A) Geogrid: A polymer plastic formed into a very open, grid-like structure with large apertures fabricated for use as soil reinforcement.

(B) Uniaxial Grid: A geogrid, which has been manufactured with high tensile strength and modulus in one direction only.

(C) Biaxial Grid: A geogrid, which has been manufactured with high tensile strength and modulus in two directions, along the roll length and across the roll width.

(D) Direction of Reinforcement: Refers to the orientation that the geogrid is used in for a particular project; along the roll for uniaxial geogrid and either along or across the roll for biaxial geogrid.

(E) MD: Machine direction.

(F) XD: Cross machine direction.

223.3 QUALIFICATION OF THE MANUFACTURER:

A manufacturer of geogrid reinforcement products shall provide documentation of at least five years experience in successful installations of their geogrid product. The proposed reinforcement material shall have been used on at least 10 projects. The proposed material may be an improved product of that used on the earlier installations. References listing Owner, Engineer, and Contractor for these projects shall be submitted to the Engineer.

223.4 MATERIALS:

Geogrid: The geogrid shall have high tensile modulus in relation to the material being reinforced, with large open areas to permit significant mechanical interlock with the material being reinforced and with continuity of tensile strength through all ribs and junctions of the structure. The geogrids shall have high, long term design strength and shall be resistant to both ultraviolet degradation and all forms of biological or chemical degradation normally encountered in the material being reinforced. The geogrids shall be designed for a minimum life of 75 years. Documentation substantiating the life of the material shall be submitted to the Engineer for approval.

223.5 DESIGN GUIDELINES:

The design method and reinforced design strengths used by the Contractor shall be in general conformance with the FHWA Publication on "Interim Guidelines for Design, Specification, & Contracting of Geogrid Stabilized Earth Slopes on Firm Foundations" (December 1991)(reference). The following guidelines shall be used for the Contractor's design of the mechanically stabilized slopes:

Mechanically stabilized earth slopes shall be designed for both external and internal stability. To be internally stable, the mechanically stabilized slopes shall be coherent and self-supporting under the action of its own weight and any externally applied forces. The reinforcements shall be sized and spaced to preclude rupture under the stresses that they are required to carry and to prevent pull out from the soil mass.

Mechanically stabilized slopes shall be stable against sliding due to the gravity force and lateral pressure of the soil retained by the slope and is safe against foundation failure and overall slope failure.

The design shall provide the following factors of safety:

Internal Stability		
Slope Stability		FS = 1.5
Pull Out Resistance		
	On-site Cohesive Soil	FS = 2.0
	Granular Soil	FS = 1.5
External Stability		
	Sliding	FS = 1.5
	Deep Seated	FS = 1.5
	(overall stability)	

Durability requirements shall be in accordance with the reference and be capable of withstanding direct exposure to sunlight for 60 days with no measurable deterioration, as measured according to ASTM D 4355. The Engineer shall require submittal of certification that the selected material meets these requirements.

In the absence of product specific chemical durability test results, the factor of safety for chemical degradation shall be taken as 2.0.

Construction procedures shall be accomplished in such a manner as to prevent damage to the grid or movement of the grid within the fill.

223.6 HANDLING, AND STORAGE:

Contractor shall check the geogrid upon delivery to ensure that the proper material has been received.

During all periods of shipment and storage, the geogrid shall be protected from temperatures greater than 60° C (140° F), and all deleterious materials that might otherwise become affixed to the geogrid and adversely affect its performance. Contractor shall follow manufacturer's recommendations in regards to protection from direct sunlight.

All tears, cracks, punctures or flaws to the structural geogrid coating, if applicable, may be repaired by placing a suitable patch over the defective area as approved by the Engineer. If the substrate of a coated geogrid is exposed at roll ends or as a result of cuts, cracks, punctures, or flaws, the exposed area shall be sealed with a coating solution identical to the original coating. The coating solution shall be applied by dip coating or spread coating with an applicator. The area shall be thoroughly clean and dry, and working temperatures shall not be below 0° C (32° F). All exposed substrate or repair patches shall be treated in the same manner.

223.7 CONSTRUCTION:

At least four (4) weeks prior to installation of the structural geogrid reinforcement, the Contractor shall submit to the Engineer for review six sets of installation drawings, signed and sealed by a Registered Professional Engineer, showing the proposed location of all geogrid material, together with connection details, if applicable. The Engineer shall return two (2) sets of drawings to the Contractor. The Contractor shall obtain Engineer approval prior to commencing installation of the structural geogrid reinforcement.

A qualified and experienced representative of the geogrid manufacturer or of its supplier shall be on site, for a minimum of two days at the start of installation, to advise the Contractor and the Engineer in the proper construction/installation techniques. Thereafter, the representative shall be available on an as needed basis.

Foundation soil shall be excavated to the lines and grades shown on the drawings or as requested by the Engineer. Over excavated areas shall be filled with compacted backfill material. As a minimum, foundation soil shall be proof rolled prior to backfill and geogrid placement.

Geogrid shall be laid at the proper elevation and orientation as shown on the construction drawings or as requested by the Engineer. Correct orientation (roll direction) of the geogrid shall be verified by the Contractor. Geogrid may be temporarily secured in-place with staples, pins (civil applications), sand bags, or backfill as required by fill properties, fill placement procedures, or weather conditions, or as requested by the Engineer.

Backfill shall be placed, spread, and compacted in such a manner to minimize the development of wrinkles in and/or movement of the geogrid. Tracked construction equipment shall not be operated directly upon the geogrid. A minimum fill thickness of 150 mm (6") is required prior to operation of tracked vehicle over the geogrid. Turning of tracked vehicles should be kept to minimum to prevent tracks from displacing the fill and damaging the geogrid. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 16 kph (10 mph). Sudden braking and sharp turning shall be avoided.

All backfill material, imported or reused from over excavation, used in the construction of the reinforced earth walls shall comply with the wall system manufacturer's specifications and the soils report.

Contractor shall warrant that all imported material is free of hazardous contaminants. The Contractor shall inform the Engineer of its material source. Material shall not be removed from the site until the Engineer has tested it and approved its suitability for the purpose intended.

Any geogrid damaged during installation shall be replaced by the Contractor at no additional cost to the County

223.8 MEASUREMENT:

The item shall be measured by computing the sum of the products of the average height of the face of the reinforced slope in each 50 meter (150') long section beginning at the start of each section of reinforced slope section plus any end section less 50 meters (150') which shall be computed in a similar manner. The average height of the face shall be the average of the height at the beginning and end of each section measured along the face of the slope (Slope Height).

223.9 PAYMENT:

Payment for this item shall be made at the unit price bid per square meter (yard) for the item Reinforced Slope Protection which price shall be full payment for the item, including, but not limited to, geogrids and fill material within the reinforced slope areas.

Section 301 Subgrade Preparation (Include on PM-10 projects that have pay items for earthwork and use soil cement base or lime slurry stabilization. Added October 10, 2002)

SECTION 301 SUBGRADE PREPARATION

301.1 DESCRIPTION add the following:

Roadway pavement for the purpose of this specification shall include Asphalt Chip Seal.

301.3 RELATIVE COMPACTION

Replace the first sentence "The subgrade shall be scarified and loosened to a depth of 150 mm." with "Subgrade scarification shall be performed as required in Section 311 for construction of the Soil Cement Base Course."

Section 302 Subgrade Preparation (This is a fill-in specification to be used for a stabilized penetrate and chip seal. Revised April 1, 1999)

SECTION 302 SUBGRADE PREPARATION FOR A STABILIZED PENETRATE AND CHIP ROAD

This section shall govern existing soil subgrade material, imported soil subgrade material or aggregate base material mixed with a soil stabilizer to form a stable base prior to the placement of prime coat, chip seal and fog seal. This item shall consist of a mixture of subgrade soil or base material, soil stabilizer and water and compacted at or near optimum moisture content.

Subgrade Preparation shall also include the preparation of subgrade, shoulders, and ditches to the required lines and grades as shown on the plans or where required by the Engineer.

Any disposal area selected by the Contractor shall be approved by the Engineer prior to its use as such. Disposal of waste in approved areas shall be made in such a manner that natural drainage will not be blocked or diverted unless requested by the Engineer.

302.1 MATERIALS:

Soil stabilizer such as -----, manufactured by -----, or an approved equal shall be used. Water shall comply with Section 225 of the Uniform Standard Specifications. The soil for the mixture shall consist of the subgrade material existing in the roadway or approved import material or aggregate base. The material shall not contain more than 5 percent gravel or stone retained on a 3-inch (75 mm) sieve.

It shall be demonstrated by laboratory tests that characteristics of the soil will be adequately modified by the specified Stabilizer content.

302.2 EQUIPMENT:

An ample number of machines, combination of machines and equipment shall be provided and used to produce the completed stabilized base meeting the requirements for soil pulverization/scarification, mixing, stabilizer distribution, water application, incorporation of materials, compaction, finishing, grading and shaping as provided in these specifications.

302.3 CONSTRUCTION METHODS:

Before undertaking construction of the stabilized soil subgrade or base, the area to be stabilized shall be compacted to a minimum of 90%, in accordance with ASTM D-698A, true to line and grade as requested by the Engineer or as shown on the plans. During this process any unsuitable soil material, including excess material retained on a 3-inch (75 mm) sieve, shall be removed and replaced with acceptable material. The compacted surface shall be at the proper elevation as specified, shown on the plans, or as requested by the Engineer, for the top of stabilized subgrade or base. At completion of this phase, the material and surface shall be approved by the Engineer before proceeding.

The soil or base material shall be scarified, pulverized, mixed with water and stabilizer, compacted and finished in lengths permitting the full roadway width to be completed in the time period specified by the soil stabilizer supplier, if any. Such lengths will generally be not less than ½ mile (.80 km) for 30 foot (9.1 meter) road width, per day.

302.3.1 Pulverizing: Before application of stabilizer, soil or base to be processed shall be scarified to a minimum depth of 6 inches, or the depth specified on the plans. The material shall be damp at the time of scarifying to reduce dust to a minimum and to aid in pulverization. If the soil contains clods, it shall be pulverized until not less than 80 percent, exclusive of gravel or stone, will pass a No 4 sieve (4.75 mm).

302.3.2 Application of Stabilizer: The quantity of stabilizer shall be by gallons per mile (liters per kilometer) of roadway soil as determined by the laboratory and/or as requested by the Engineer and shall be applied uniformly on the soil in a manner satisfactory to the Engineer, preferably the stabilizer will be diluted with water in a water truck and be applied by sprinkling with tank trucks equipped with pressurized spray bars and suitable apparatus. One mile (kilometer) of roadway is defined as one mile (kilometer) long by 30 feet (9.1 m) wide by 6 inches (150 mm) deep, or the depth specified on the plans. The entire operation of spreading and mixing shall be conducted in such a manner as will result in a uniform soil or base, stabilizer and water mixture for the full design width and depth. The percentage of moisture in the soil or base, at the time of stabilizer water solution application, shall not exceed the quantity that will permit a uniform and intimate mixture of the soil and stabilizer during mixing operations.

302.3.3 Mixing: Mixing with addition of water as required shall be continued until the product is uniform in color and at or near optimum moisture content. The mixed material shall be kept at the specified moisture content up to and during compaction.

302.3.4 Optimum Moisture: Optimum moisture requirements and field tests of moisture density shall be determined in accordance with AASHTO T- 99, T- 191, T- 217, or ASTM D- 698, D- 2922, D- 3017 on representative samples of soil/base - stabilizer mixture obtained from the area being processed. At the time of compaction, the moisture content shall be within ± 4 percent of optimum but not greater than that quantity which will cause the subgrade material to become unstable during the compaction and finishing process.

302.3.5 Compaction: After mixing is complete, the mixture shall be carefully placed in a uniform loose depth which will provide a surface true to grade and section when compacted. Unless otherwise requested by the Engineer, initial compaction shall be by means of a tamping, grid, or pneumatic roller. After the tamping roller has partially walked out, pneumatic rollers shall be used. Finish rolling with a smooth steel wheel. Density of final product shall be not less than 95 percent of maximum as determined by AASHTO or ASTM as specified above.

302.3.6 Finishing: As compaction nears completion, the surface of the subgrade shall be shaped to required lines, grades and cross-section. When required, the surface shall be lightly scarified with spike tooth harrows or other approved equipment to remove imprints left by equipment. The completed subgrade shall not vary more than $\frac{1}{2}$ inch (13 mm) in thickness and not more than $\frac{1}{4}$ inch (6.5 mm) above or below required grade and cross-section. It shall be free of surface cleavage planes, cracks, or loose material. As a final operation, the surface shall be very lightly scalped with a motor grader, moistened with a water fog spray and rolled with a pneumatic roller as requested by the Engineer.

302.3.7 Deficiency: When in the opinion of the Engineer there is a reason to believe that a deficiency in thickness exists, sections will be dry sawcut or other approved method to determine the thickness. If there is a deficiency, the complete subgrade preparation process will have to be repeated to the proper depth from scarification at no additional cost to the Contracting Agency.

302.3.8 Maintenance: The Contractor shall maintain the surface until it has been covered with the designated bituminous wearing course. Minor surface pits may be filled with compacted bituminous surfacing, if authorized by the Engineer. Immediately prior to the placing of the bituminous prime coat, the surface shall be very lightly scalped with a motor grader to remove all loosened material from the surface.

302.4 Measurement:

Measurement of the stabilized subgrade will be by the square yard (square meter) constructed to the required depth, completed and accepted.

Measurement of the stabilizer will be by the number of gallons (liters) or tons (tonnes) (concentrate) mixed with the subgrade soil/base.

302.5 Payment:

Payment will be made for the applicable items at the contract unit prices bid in the proposal, and shall constitute full payment for furnishing all material, equipment, tools, labor, and incidentals necessary to complete the work and for carrying out the maintenance provisions.

The cost of water and watering will be included in the price bid for the construction operation.

No measurement or payment will be made for any imported earth materials unless they are required for fill and then they will be measured and paid for in accordance with Section 211.

Section 303 Grade and Shape Subgrade (Include on PM-10 projects that have small amounts of earthwork and use soil cement base or lime slurry stabilization. Revised 11/15/2004)

SECTION 303 GRADE AND SHAPE SUBGRADE

Grade and Shape Subgrade shall conform to and duplicate the requirements for Subgrade Preparation as defined in Section 301 Subgrade Preparation except for the scarification and re-compaction requirement under roadway pavements. The subgrade stabilization bid items within this project fulfill all required scarification and associated re-compaction needs under new roadway pavement. Roadway pavement for the purpose of this specification shall include Asphalt Chip Seal.

Measurement for Grade and Shape Subgrade will be by the square meter (yard). The area to be measured will be the total accepted area of new roadway pavement and unpaved roadway shoulders. Project earthwork consisting of Roadway Excavation, Borrow Excavation, and Fill Construction shall not be measured; such earthwork shall be included in the price bid for Grade and Shape Subgrade.

Section 311 Soil Cement Base Course (Include on PM-10 Projects using soil cement base course. Revised July 31, 2002)

SECTION 311 SOIL CEMENT BASE COURSE

311.2 MATERIALS

Delete the last sentence of this section "It shall be demonstrated ..." and add the following:

Portland Cement shall be ASTM C-150, Type II. The amount of cement used on each site shall be documented by the Contractor and reported to the Engineer. The method used for documentation shall be agreed upon prior to the start of the project. Cement delivered in standard sacks from commercial producers will be assumed to have a mass of 42.6 kg (weigh 94 pounds) per sack and need not be weighed. Weighmaster's Certificates shall be submitted for bulk cement in accordance with Section 109.2.

311.4.2 Application of Cement

Add the following to the end of the section:

The cement spread rate for this project shall be based on 1922 kg/m³ (120 lbs/ft³) dry weight of the soil unless otherwise directed by the Engineer.

[Note to Engineer: verify percent of cement and the dry weight of soil with the County materials laboratory.]

311.4.7 Deficiency

Replace Section 311.4.7 with the following:

311.4.7 Deficiency: When in the opinion of the Engineer there exist deficiencies in mixing depth or cement content, the Contractor shall verify to the Engineer the mixing depth or cement content and correct any found deficiencies prior to compaction.

311.4.8 Curing

Replace Section 311.4.8 with the following:

311.4.8 Curing: The finished soil-cement shall be kept continuously moist using fog or gravity bar spray until the asphalt binder for the covering chip seal is applied; the asphalt binder shall be applied within five days. The Engineer shall approve the spray equipment before construction is begun.

Section 312 Cement Treated Base (Include when it is necessary to include the cement content by weight. Revised April 1, 1999)

SECTION 312 CEMENT TREATED BASE:

Section 312 add the following:

Cement treated base may be mixed in either a traveling plant or in a stationary plant at the option of the Contractor. If transit mixers are to be used, the type of mixer must be approved by the Engineer.

The amount of cement to be used shall be _____ percent by weight of the dry aggregate or as required by the Engineer. Aggregate for Cement Treated Base shall conform to the requirements of Section 702.

The Cement Treated Base shall be cured in accordance with Section 312.6 except that a bituminous curing seal shall not be used. Contractor shall keep the surface of the compacted base continuously moist until overlaid.

Section 315 Bituminous Prime Coat (Include if a bituminous prime coat may be required. Revised May 6, 2002)

SECTION 315 BITUMINOUS PRIME COAT (CONTINGENT ITEM)

The bituminous material shall be Grade MC-70 or MC-250 liquid asphalt (*70 cold weather, 250 hot weather*) as determined by the Engineer. Prime coat shall be applied to the total width of the prepared subgrade at the rate of 1.8 l/m² (0.4 gallon per square yard) unless otherwise specified by the Engineer. Prime Coat shall be allowed to penetrate for not less than 48 hours prior to paving. An application of dry or slightly damp chips may be placed over the penetration coat to allow traffic to use the roadway. Prior to paving or application of another surface treatment the roadway shall be swept.

Section 321 Asphalt Concrete Pavement (Include on projects when the plans do not identify the pavement mix design method to be used. Delete the mix design method not being used. When Superpave is used indicate Low or Heavy traffic. Revised February 25, 2004)

SECTION 321 ASPHALT CONCRETE PAVEMENT

321.1 MATERIALS AND MANUFACTURE add the following:

Asphalt concrete mix design shall use **[Marshall Mix Design method.] [Superpave Mix Design for Heavy Traffic.]**

Section 321 Asphalt Concrete Pavement (Include on projects with new asphalt pavement length greater than 0.5 miles (800 m) and a functional classification of collector or higher. The project must have a minimum of two (2) courses of Hot Mix Asphalt in which the compacted depth of each layer is 1.0 inch (25 mm) or greater and/or overlay with a minimum thickness of 1.5 inches (40mm). To insure proper project funding include the pay item Rideability with an Allowance estimated at 10% of the surfacing course costs. Revised 3/15/2004)

321.6 CORRECTIVE REQUIREMENTS FOR DEFICIENCIES:

Section 321.6 add the following:

321.6.7 Pavement Smoothness (Rideability): Pavement smoothness payment adjustments shall only apply to roadways with new asphalt pavement surfacing length greater than 0.25 miles (402 m), a functional classification of collector or higher, and a posted speed limit of 40 mph (65 km/hr) or greater. When the new asphalt pavement has a minimum of two courses of hot mix asphalt, each layer being 1.0 inch (25 mm) or greater; or the pavement has a new overlay of at least 1.5 inches (40 mm) the final pavement surface shall be evaluated for smoothness by the Engineer.

Prior to the placement of the final course of pavement, the Engineer will furnish the Contractor with an International Roughness Index (IRI) value that results from the Engineer's evaluation of the material placed to date. The actual time of this "trial" evaluation will be coordinated between the Engineer, the Contractor, and the MCDOT Road Management Section (RMS) Supervisor. This evaluation will be limited to one (1) test run in a single lane in each direction of travel. The IRI value will serve as a guide to the Contractor in evaluating his current level of conformance with the smoothness specification. The IRI value for the final course of pavement will be the basis for determining payment adjustments for smoothness. The smoothness adjustment will be in accordance with the RIDEABILITY ADJUSTMENT SCHEDULE.

321.6.7.1 Evaluation Method: The MCDOT Road Management Section shall evaluate the final pavement surface for smoothness, using the MCDOT IRI vehicle equipped with an International Cybernetics Corp. Laser Road Profiler. The IRI value is the calculated measurement of the deviation of a pavement surface from a true planar surface. The IRI data is typically collected at the posted speed limit, however speeds may range from 20-60mph. A zero IRI value would indicate a perfectly smooth pavement surface, while increasing IRI values would correspond to an increasingly rough pavement surface. IRI values will be calculated in inches (meters) of vertical displacement for every 0.10 mile (160 meters) lane segment and normalized to inches/mile. [Example: a 0.10-mile section yielding an actual vertical displacement of ten (10) inches would be normalized to an IRI value of 100 inches/mile.]

The final pavement surface being evaluated will be divided into 0.10-mile (160 meter) road segments and individual lanes. The final road segment will include any remaining portion of a segment not equaling 0.10 miles (160 meters). [Example: 1.52 miles (2446.2 meters) of pavement divides into 15 segments with the last one measuring 0.12 miles (206.2 meters).] The IRI is calculated for each 0.10-mile (160 meter) segment and shall be averaged (three runs per lane) to determine the IRI value for that segment. All values obtained from the RMS IRI vehicle shall be final.

The following shall be subject to smoothness testing:

1. Roadway lanes that are 0.25 miles (402 meters) or greater in length.
2. Smoothness data will not be computed for the following project sections;
 - Lanes less than 0.25 miles (402 meters) in length.
 - Shoulders.
 - Pavement on horizontal curves that require the test vehicle to travel at speeds less than 20 mph (32 km/hr).
 - Test segments with an irregularity that invalidates the test results as may occur when cattle guards, railroad tracks, valley gutters, etc, are present.
3. Bridge decks shall be included only if paved as part of the project. If bridge decks are not included as part of the construction project, profile testing will be suspended

before the first joint between the asphalt surfacing and the bridge/approach slab and restarted after the last joint between the bridge/approach slab and the asphalt surfacing.

4. Smoothness measurement testing will start and stop at the transverse joints of the project limits.

When requested by the Engineer, the Contractor shall provide traffic control for smoothness testing to allow the test vehicle to safely travel through signalized intersections and/or stop controls oriented in the test direction of travel.

The Contractor shall notify the Engineer within ten (10) working days after completion of all pavement repairs that the pavement is ready for smoothness testing. The Engineer will have the testing conducted within twenty (20) working days after notification by the Contractor. All Asphalt concrete pavement shall conform to Section 321 and 325 prior to smoothness testing.

When the smoothness measurements indicate corrective work is required, the Engineer shall notify the Contractor in writing within ten (10) working days after the completion of the smoothness testing. The Contractor shall have twenty (20) working days following such notification to make repairs to the pavement.

The Contractor shall notify the Engineer within ten (10) working days after completion of all pavement repairs that the pavement is ready for smoothness re-testing. The Engineer will conduct the testing within twenty (20) working days after notification by the Contractor.

No testing shall be conducted during rain or under other conditions deemed inclement by the Engineer. During testing the roadway must be free of moisture and other materials that might affect the evaluation. Any work associated with preparing the roadway for the evaluation, such as but not limited to sweeping, will not be measured for payment.

321.6.7.2 Payment Adjustment for Rideability: All Asphalt concrete shall conform to Section 321 and 325 prior to final payment adjustment for smoothness. Positive adjustments for rideability **shall not be made** for those areas subsequently reviewed and determined by the Engineer to be otherwise defective. The Area shall be considered defective if it does not conform to Section 321 and 325 requirements for Air Voids, Binder Content, Gradation, Density, and/or Pavement Thickness.

Payment adjustments shall be made under the bid item Rideability. Payment to the Contractor shall be based on the IRI value according to the Rideability Adjustment Schedule. The adjustment will be applied to each segment of each lane subject to smoothness testing. The rideability payment will be the indicated percent adjustment multiplied times the adjusted bid price for the surface course quantities of the hot mixed

asphalt, asphalt overlay, or rubber asphalt overlay incorporated into the final construction.

Payment for Rideability will be distributed based on segment areas; the area of each lane segment will be the segment length times the segment width. The segment width shall be the striped traffic lane width or modified lane width. The width for exterior lanes will be the striped traffic lane width modified to include the asphalt area of adjacent bicycle lanes, paved shoulders, and short auxiliary lanes. The width of the innermost traffic lanes will be the striped traffic lane width modified to include the asphalt area of adjacent asphalt paved medians and left turn bays.

RIDEABILITY ADJUSTMENT SCHEDULE

IRI (inches per mile)	IRI (meters per kilometer)	PERCENT ADJUSTMENT
≤ 50	≤ 0.79	+10
51 - 60	0.80 - 0.95	+05
61 - 80	0.96 - 1.26	0
81 - 100	1.27 - 1.58	-05
101 - 110	1.59 - 1.74	-10
111 - 120	1.75 - 1.89	-25
>120	>1.89	RxR Required

NOTES:

All IRI values in the English system will be rounded to the nearest whole number. (Example: 75.5 shall be rounded to 76.)

All IRI values in the metric system will be rounded to the nearest hundredth. (Example: 0.926 shall be rounded to 0.93.)

“RxR Required” is the Removal and Replacement of the defective area.

Section 322 Asphalt Concrete Overlay (Include on projects with an asphalt pavement overlay extending greater than 0.5 miles (800 m) in length, has a functional classification of collector or higher, and the overlay compacted depth is a minimum of 1.5 inches (40mm). Also insert Section 321.6.7 of these General Special Provisions. Revised 3/15/2004)

322.5 CONSTRUCTION METHODS

Section 322.5 add the following:

Rideability shall be tested in accordance with provisions of Section 321.6.7 Pavement Smoothness.

Section 325 Asphalt-Rubber Concrete, Gap Graded (Include with projects that use asphalt-rubber concrete and the plans have not designated the traffic parameter “Heavy Traffic” or “Low Traffic” for mix design. Added November 5, 2003)

SECTION 325 ASPHALT - RUBBER CONCRETE, GAP GRADED

325.2.3 MIX DESIGNS add the following:

The asphalt-rubber concrete job mix design shall be for **[insert Heavy or Low]** Traffic conditions.

Section 325 Asphalt-Rubber Concrete, Gap Graded (Include on projects with an asphalt rubber pavement surface course extending greater than 0.5 miles (800 m) in length, a future functional classification of collector or higher, and the asphalt-rubber concrete surface course compacted depth is a minimum of 1.5 inches (40mm). Also insert Section 321.6.7 of these General Special Provisions. Revised 3/15/2004)

SECTION 325 ASPHALT - RUBBER CONCRETE, GAP GRADED

325.4 CONSTRUCTION METHODS

Section 325.4 add the following:

Rideability shall be tested in accordance with provisions of Section 321.6.7 Pavement Smoothness.

Section 330 Asphalt Chip Seal (Include in projects requiring a two day waiting period between placement of the prime coat and chip seal coat. Revised April 1, 1999)

SECTION 330 ASPHALT CHIP SEAL

This item shall fully comply with Section 330 of the Uniform Standard Specifications except that the application of the chip seal coat shall not begin before two days after the application of the prime coat.

The emulsified asphalt shall be grade RS-2h or CRS-2h and shall fully comply with Section 713 of the MAG Uniform Standard Specifications. Application shall be at the

rate of 0.40 gallons per square yard (1.67 liters per meter²) unless otherwise specified by the Engineer.

The stone chips shall fully comply with Section 716 of the Uniform Standard Specifications except precoating is not required and gradation shall be as follows:

TABLE 716-1	
For Low Volume Traffic Only	
Sieve Size	% Passing
1/2 in. (12.5 mm)	100
3/8 in. (9.5 mm)	97-100
1/4 in. (6.3 mm)	65-100
No. 8 (2.3 mm)	0-10
No. 200 (.075 mm)	0-1

Application shall be at the rate of approximately 14.12 kg per meter² (26 pounds per square yard).

Payment for this item will be made at the contract unit price bid per tonne (ton) for Liquid Asphalt for Chip Seal (RS-2 OR CRS-2h) and for Stone Chips.

Section 330 Asphalt Chip Seal (Include in projects requiring a double chip seal. For PM-10 projects using soil cement base course, include the special provision for Section 311 and include the PM-10 Structural Section Detail in the construction plans. Revised 11/18/2004)

The PM-10 Structural Section Detail is found: P:\Engineering\samir\Chipseal-Section.dgn

SECTION 330 ASPHALT CHIP SEAL

Asphalt chip seal shall be constructed in accordance with Section 330, except as modified below:

330.1 DESCRIPTION:

The work shall consist of a double chip seal surface application, Low volume chips (modified) over High volume chips (modified), over existing AC pavements or on unpaved roads. The asphalt binder and application rate for the cover material shall comply with Table 2 in Section 330.2.1 unless otherwise specified by the Engineer:

All material sources must be approved by the Engineer prior to their use. Once approved, material sources shall not be changed without the approval of the Engineer. Contractor shall submit material samples at least seven days prior to start of construction. When requested, additional samples shall be furnished during the

construction period at no cost to the County. Material sample submittal is a non-pay item.

330.2 MATERIALS:

330.2.1 Asphalt Binder – AC-15-5TR:

This material shall consist of an asphalt cement to which has been added a minimum of 5% ground tire rubber and 2-3% SBS polymer.

The ground rubber shall be any crumb rubber, derived from processing whole scrap tires or shredded tire materials taken from automobiles, trucks, or other equipment owned and operated in the United States. The processing shall not produce, as a waste, casings, or other ground material that can hold water when stored or disposed above ground. Rubber tire buffings produced by the retreading process qualify as a source of crumb rubber.

The finished asphalt-ground tire blend shall be smooth, homogeneous and comply with the following specifications listed in Table 1:

TABLE 1		
GROUND TIRE RUBBER / SBS POLYMER COMBINATION ASPHALT BINDER		
Property	Test Method	Requirement
Ground Tire Rubber Content, %	Certificate of Compliance	5.0 min.
SBS Polymer, %	Certificate of Compliance	2-3
Penetration @ 25° C (77° F), 100g / 5 sec, dmm	ASTM D-5	55 - 90
Kinematic Viscosity @ 135° C (275° F), cSt	ASTM D-2170	2000 max.
Softening Point, ° C (° F)	ASTM D-36	60 (140) min.
Solubility, %	ASTM D-2042	97.5 min.
Elastic recovery @ 25° (77° F), 20 cm elongation, 5 cm / minute, % Recovery after 1 hour	ASTM D-6084 (Modified) Modify 10cm to 20cm	55 min.
Separation of Polymer, 163° C (325° F), %	See Note 1	4 max
Retained Penetration Ratio (RTFO Pen. @ 25° C (77° F), 100g / 5 sec) (Original Pen. @ 25° C (77° F))	ASTM D-5	0.6 – 1.0

Note 1: A 350-gram sample of the asphalt-ground rubber blend is poured into a friction top, pint can {approximately 3.5-inch diameter and 4-inch height} and stored for 48 hours at 325° F. Upon completion of storage time the sample is visually examined for separation of polymer from the asphalt (smoothness and homogeneity). If after visual evaluation a question still exists about the separation of

polymer, samples will be taken from the top and bottom for softening point determination. A difference between the softening points of top and bottom samples of 4% or more, based on the average of the top and bottom softening points, constitutes separation. (Reference Texas DOT test procedure Tex-540-C)

Storage, Heating and Application Temperatures:

Asphalt containing particulate modifiers may be susceptible to separation of the modifier. Appropriate circulation or agitation in storage shall be provided if separation of the modifier is expected, suspected or if the modified asphalt will be stored at elevated temperature for more than one day before use.

Application and storage temperatures shall comply with the following:

Application			
Type-Grade	Recommended Range	Maximum Allowable	Heating and Storage Maximum
AC-15-5TR	325-360° F	375° F	** 375° F

** Maximum temperature for storage by the asphalt supplier or the Contractor shall be 360° F. For AC-15-5TR designated for surface treatment work, the temperature may be increased to a maximum of 375° F by the supplier loading through an in-line heater, or with the Engineer's permission, these materials may be heated to a maximum of 375° F by the Contractor just prior to application. In any case, the heating, storage, and application temperatures used shall be the lowest temperatures practical.

Certificates of Compliance for AC-15-5TR shall be provided by the Contractor in accordance with Section 106.

Certified weigh tickets for AC-15-5TR shall be provided by the Contractor with each truck load, in accordance with Section 109.2.

Each transport of AC-15-5TR shall be accompanied by a certification that the material contains the minimum ground tire content specified and the tire rubber conforms to the origin and processing requirements. The certification shall show the weights of ground tire rubber and asphalt raw materials used to manufacture that batch. The Department reserves the right to audit the amount of tire rubber received versus the amount of product produced.

The asphalt binder application rate for the cover material is estimated according to Table 2 below, unless otherwise specified by the Engineer:

TABLE 2
ASPHALT BINDER APPLICATION RATE

Surface	First layer	Second layer
AC Pavements	0.40 gal/sy AC-15-5TR	0.37 gal/sy AC-15-5TR
Unpaved surface (AB, Select, etc.)	0.45 gal/sy MC-250 0.37 gal/sy MC-800	0.40 gal/sy AC-15-5TR
Unpaved surface (stabilized millings)	0.33 gal/sy MC-250, MC-800	0.33 gal/sy AC-15-5TR

330.2.2 Aggregate: The cover material shall meet the requirements of Section 716, except as modified below:

The cover material shall be a modified Low volume aggregate chip and shall comply with the following specifications listed in Table 3:

TABLE 3	
MODIFIED LOW VOLUME AGGREGATE CHIP GRADATION	
Sieve Size	Percent (%) Passing
(1/2")	100
(3/8")	97-100
(1/4")	65-100
(No. 8)	0-10
(No. 200)	0-1

High volume aggregate chips shall be in accordance with Section 716, except the No. 200 sieve shall be 0-1% passing.

The aggregate chip application rate for the cover material is estimated according to Table 4, unless otherwise specified by the Engineer:

TABLE 4		
AGGREGATE CHIP APPLICATION RATE		
Surface	First layer	Second layer
AC Pavements	21 lbs/sy	15 lbs/sy
Unpaved surface (AB, Select, native, stabilized millings etc.)	23 lbs/sy	18 lbs/sy

If moist chips are used, the total moisture content shall not exceed 1.5%.

It is the responsibility of the Contractor to determine that the asphalt binder is compatible with the aggregate.

Certified weigh tickets for aggregate are required.

Precoating of aggregate chips shall produce completely coated chips. The percentage of asphalt used for coating shall be 0.7% unless otherwise directed by the engineer.

330.2.3 Material Testing: Contractor is responsible for Quality Control of materials used. Testing done by the Engineer will be for assurance that materials used conform to the specifications and shall not be considered part of the Contractor's quality control.

Asphalt Binder: Provisions for properly sampling from distributor trucks or on-site bulk storage units shall be made by the Contractor. Sampling shall be done by Contractor and witnessed by the Engineer in accordance with the latest edition of ASTM D-140, "Standard Methods of Sampling Bituminous Materials". Testing will be done by the Engineer in accordance with the latest edition of ASTM or AASHTO.

The minimum amount of asphalt binder sampling and testing shall be once per 500 tons of binder. Material found in non-compliance will be rejected and removed from the job site. No payment will be made for rejected material. The project shall not resume until the new material is tested and found in compliance. No lost time will be considered as a result of material being found in non-compliance.

Cover Material: Cover material will be sampled and tested by the Engineer in accordance with the latest edition of ASTM C-136, "Sieve Analysis of Fine and Coarse Aggregates". The Engineer will sample aggregate cover material for acceptance at the point of placement. Material used for the analysis shall be that which is collected in the collection apparatus, placed on the pavement, when verifying spread rate.

The minimum amount of cover material sampling and testing shall be once per day. Material found in non-compliance will be rejected. No payment will be made for rejected material. The area represented by the test shall be the area covered the day the sample was taken. No lost time will be considered as a result of material being found in non-compliance.

Moisture Content: Moisture content will be sampled and tested by the Engineer in accordance with the latest edition of ASTM C-566, "Total Evaporable Moisture Content of Aggregate by Drying". Aggregate exceeding the moisture content will be rejected. The operation will cease until Contractor can show the moisture content is at an acceptable limit.

330.3 TIME OF APPLICATION AND WEATHER CONDITIONS:

The chip seal shall not be applied unless the pavement temperature or ground surface temperature of the area to be chipped, measured in the shaded area, is at least 70° F and rising.

330.4 CONSTRUCTION METHODS:

330.4.1 Preparation of Surfaces: Contractor shall remove and dispose of raised pavement markers (if any) prior to the placement of the chip seal. Removal shall be by chipping, grinding, or other method approved by the Engineer.

When necessary, cleaning of the existing pavement surface shall be supplemented by hand brooms or other methods, approved by the Engineer, to assure a good bond between the asphalt binder chip seal and the pavement surface. Power brooms or pick up brooms alone may not be adequate to thoroughly clean the surface. Contractor shall have a water truck present and operating at all times, when operating power brooms, to keep dust levels down to the satisfaction of the Engineer. If water is used, the pavement shall be dry before applying the asphalt binder, when using non-emulsified asphalt binder. Contractor shall conduct all sweeping operations in the same direction as traffic flow.

A Tack Coat is not required prior to chip sealing.

Excess chips shall be swept from the surface prior to the application of the second chip layer. Allow 24 hours prior to sweeping.

Actual pavement dimensions may vary from those shown on plans or on the road list. Contractor shall clean, chip, and fog seal all existing pavement.

330.4.2 Application of Bituminous Material: The bituminous material shall be applied the same day the pavement is cleaned.

330.4.3 Application of Cover Material: The cover material (chip) spreader shall be a self-propelled machine with an aggregate receiving hopper in the rear, belt conveyors to carry the aggregate to the front, and a spreading hopper equipped with a full width distribution auger and spread roll. The spreader shall be in good mechanical condition and be capable of applying the cover material uniformly across the spread at the specified rate.

Trucks for hauling cover material shall be tailgate discharge and shall be equipped with a device to lock onto the hitch at the rear of the cover material spreader.

Haul trucks shall also be compatible with the cover aggregate spreader so that the dump bed will not push down on the spreader when fully raised or have too short a bed, which results in aggregate spillage while dumping into the receiving hopper.

330.4.4 Rolling: In residential areas, rollers shall be skirted so that any cover material that should stick to the tires during rolling will be thrown back down to the pavement instead of outward into neighboring property.

Three operational pneumatic-tired rollers, with operators shall be provided to accomplish the required embedment of the cover material. If Contractor is working at

more than one location, there shall be a minimum of three rollers, with operators at each location.

Sufficient rollers shall be used for the initial rolling to cover the width of the aggregate spread with one pass. The first pass shall be made immediately behind the cover material spreader. Four complete passes with rollers shall be made and all rolling completed within one hour after the application of the cover material. If the spreading is stopped for an extended period, the cover material spreader shall be moved ahead or off to the side so that all cover material can be immediately rolled.

330.4.5 Joints: Paper shall be used at the beginning and end of the chip seal section to make a smooth, straight, clean transition. Paper shall also be used at concrete bridge decks.

330.4.6 Surplus Aggregate Removal: Contractor is responsible for locating and acquiring areas to stockpile materials and equipment needed for construction. Contractor shall obtain a letter of release from the property owner prior to stockpiling/equipment storage. The cost of material stockpiling, equipment storage and cleanup is incidental to the project. Contractor shall conduct all sweeping operations in the same direction as traffic flow.

Before final acceptance by the County, all private or public property and grounds occupied by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures and equipment. All parts of the work area shall be left in a condition equal to, or better than, it was prior to the start of the project.

Cleanup shall also include the daily removal of chip seal materials from manhole covers, valve covers, fire hydrant markers, gutters, curbs, sidewalks, etc. in the project area.

Contractor shall keep driveways and sidewalks clean of any loose chips, in residential areas, on a daily basis during construction and daily for one week after the application of the fog seal. Air powered blowers are not allowed.

330.4.7 Distributing Equipment: In addition to the requirements of MAG section 330.4.7 distributor trucks shall comply with the requirements of Section 404-3.02 (A) of the Arizona Department of Transportation Standard Specifications for Road and Bridge Constructions, current edition.

330.4.8 Performance: The completed chip seal shall leave a homogeneous mat, adhere firmly to the prepared surface, and have a skid resistant surface texture. Prior to fog seal, areas of the chip seal mat where the old road surface is exposed, or areas where asphalt binder lies uncovered by chips, shall be filled in by the Contractor with asphalt binder and cover material and rolled.

330.4.9 Fog Seal Coat: The fog seal coat is required when the top layer is constructed using uncoated aggregate chips, fog seal coat is not required when the top layer is constructed using pre-coated aggregate chips. Fog seal coat shall be constructed in accordance with Section 333, except as modified below:

Within 48 hours after application of the final layer of uncoated chips, surface shall receive a fog seal coat. The estimated application rate is 0.10 gal/square yard or less. The exact rate of application shall be determined by the Engineer.

330.4.9.1 Emulsified Asphalt: Emulsified Asphalt shall be grade SS-1h, as specified in Section 713, diluted in proportions of 50% water and 50% emulsified asphalt.

330.4.9.2 SAND BLOTTER (contingent): Sand Blotter shall be in accordance with Section 333, except as modified below:

Sand blotter shall be applied prior to opening the roadway to traffic, if requested by the Engineer. Contractor shall be responsible for sweeping the sand within 24 hours of opening the roadway to traffic. If the roadway is sanded, the surface shall be sanded at two to three pounds per square yard. No more sand shall be used than necessary, and the amount specified shall not be increased without prior approval of the Engineer.

330.7 PAYMENT: Payment shall be in accordance with Section 330.7 except as modified below:

Asphalt Binder:

Asphalt Binder AC-15-5TR:	Ton
Liquid Asphalt (MC-250 OR MC-800):	Ton
Liquid Asphalt MC-250:	Ton
Liquid Asphalt MC-800:	Ton

[DELETE the Liquid Asphalt items not used on the Bidding Schedule]

Stone Chips:

Stone Chips Low Volume – Modified Gradation (uncoated):	Square yard
Stone Chips Low Volume – Modified Gradation (pre-coated):	Square yard
Stone Chips High Volume – Modified Gradation (uncoated):	Square yard

[DELETE the Low Volume chip type not used on the Bidding Schedule]

Section 337 Price Adjustment for Bituminous Materials (Include in projects when asphalt prices may significantly fluctuate between the bid date and date of actual use. Requires identification of effected bid items. To insure proper project funding include the pay item 337.01000 Price Adjustment for Bituminous Materials with an Allowance to fund a 25% cost increase for bituminous materials. Revised 5/17/2004)

SECTION 337 PRICE ADJUSTMENT FOR BITUMINOUS MATERIALS

337.1 Description

Price adjustment shall be calculated based on price changes of bituminous material occurring between the date of bid opening and the date that the material is delivered or used. Price adjustment shall be bi-directional, potentially increasing or decreasing contract payments.

The term “bituminous material” as used herein shall include asphalt cement, liquid asphalt and emulsified asphalt and shall apply only to the following specific pay items requiring these materials: *[List all asphalt based bid items in project – verify list.]* Bituminous Prime Coat, Asphalt Concrete Pavement, Bituminous Tack Coat, Asphalt-Rubber Concrete Pavement, and Fog Seal (Contingent Item).

The contract unit price for each item of bituminous material shall include all costs for furnishing, hauling, handling, spreading, and mixing of the material required, including the “initial cost” of bituminous material and all applicable taxes, bonds, and insurance premiums; but excluding any difference in the cost of bituminous material that occurs between the date of bid opening and the date that the material is delivered or used and the cost of taxes, bonds and insurance directly attributed to the price adjustment amount for bituminous materials.

337.2 Measurement

Asphaltic Concrete

The approved mix design designates a range of bituminous material allowable for construction. If the amount of bituminous material exceeds the allowable range, the Contractor will not be compensated for the excess bituminous material. If the bituminous material is less than the allowable range and the asphalt concrete is found to be acceptable by the engineer, the bituminous material shall be subject to the price adjustment.

The tonnes (tons) of bituminous materials, which are present in asphalt concrete, shall be determined by tests using nuclear asphalt content gauge, extraction, ignition furnace, or other approved method. Tests shall be taken at least twice daily on a random basis. When only two tests are planned, they shall occur at placement of approximately 33% and 67% of the day's planned quantity. The arithmetic average of each day's bituminous testing that is found to be within or below the allowable range will be used to determine the amount of bituminous material present in the mix. If only one test is taken, the amount of bituminous material present in that sample will be used. The monthly production shall be the sum of the daily production.

Tack Coat, Prime Coat, Fog Seal Coat

The tonnes (tons) of emulsified products to which the adjustment will be applicable will be the tonnes (tons) of the emulsified bituminous asphalt prior to dilution. The Contractor shall weigh the truck prior to and after placing the emulsion and will be paid based upon the difference in the weight.

337.3 Payment

The "initial cost" of asphalt cement, liquid asphalt and emulsified asphalt will be the monthly cost determined by the Arizona Department of Transportation (ADOT) based on selling prices of asphalt cement published by the Asphalt Weekly Monitor, a publication by Poten & Partners, Inc.

The bituminous material "initial cost" price is issued each month in memorandum form by ADOT's Contract and Specifications Section of the Intermodal Transportation Division under "Price Adjustment for Bituminous Material" title. The price is the arithmetic average of the high and low selling prices for asphalt cement shown for the previous month in the Asphalt Weekly Monitor for the Arizona/Utah and Southern California regions.

This price will be deemed to be the "initial cost" for bituminous material of all types, grades, etc., on projects on which bids are opened during the following month. This price may be obtained from the ADOT web site:

<http://www.dot.state.az.us/ABOUT/cns/BitMat.htm>

For each item of bituminous material for which there is a specific pay item, an adjustment in compensation will be made for either an increase or decrease in the price of asphalt cement as shown in the ADOT memorandum, current for the date of use of the material, as compared to the "initial cost".

Adjustments in compensation for emulsified asphalt will be made for the bituminous material prior to dilution.

The tonnes (tons) of Bituminous Material (Asphalt Rubber) to which the adjustment will be applicable will be 0.80 multiplied times the total quantity of the item used. The adjustment will not apply to the twenty (20) percent of the material that constitutes the rubber additive.

The tonnes (tons) of bituminous materials which are paid for on an invoice basis to which the adjustment will be applicable are the tonnes (tons) which have been delivered to the project and subsequently incorporated into the work. The adjustment will be applicable on the date of use of the bituminous material.

Price Adjustment for Bituminous Materials shall include an adjustment for the actual change in cost of premiums on required payment and performance bonds, the actual change in cost of premiums for property damage and/or public liability insurance, and the change in sales tax (identified in Section 109.2.3) liability incurred as a result of the

price adjustment for bituminous materials. The Contractor shall provide documentation to determine the adjustment for the actual change in cost of premiums on required payment and performance bonds, property damage and/or public liability insurance, and sales tax.

No additional compensation will be made for any additional or increased charges, costs, expenses, etc., which the Contractor may have incurred since the time of bidding and which may be the result of any increase in the "initial cost" of bituminous material.

The Price Adjustment for Bituminous Materials will be made in the next regular monthly progress payment following actual use or application of the bituminous material and may cause an increase or decrease in payments.

Section 401 Traffic Control (Include in projects only when a Portable Radar Speed Display System is specifically requested. Revised October 22, 2001)

SECTION 401 TRAFFIC CONTROL add the following:

401.2.4 Portable Radar Speed Display System: The Contractor shall provide the number of individual portable radar speed display systems as indicated in the bidding schedule. The units are to be new and include a one-year warranty on all parts and labor. The units shall be incorporated into the traffic control plan and shall become the property of the County upon completion of use on this project. The system is to be the RU2 Fast 750 System with the Solar Power and Data Acquisition Package options as manufactured by RU2 SYSTEMS of Apache Junction, Arizona or an approved equal.

Contractor shall be responsible for equipment maintenance and security during project use. Upon completion of project use and prior to delivery to the County, the Contractor shall verify that the equipment is clean, in proper operating condition, and is free of damage from collision, misuse, or vandalism. The individual portable radar speed display systems, operating manual, parts listing, and warranty documents shall be delivered to the County warehouse or as directed by the Engineer. The Contractor shall notify the Engineer forty-eight hours in advance of the intended date of delivery. The address for the County warehouse is:

Maricopa County Department of Transportation Warehouse
2222 South 27th Avenue
Phoenix, Arizona 85009-6357

401.4.7 The Traffic Control Plan shall incorporate the use of portable radar speed display systems. The portable radar speed display systems shall be set-up and operational whenever construction operations are in progress adjacent to the roadway. Traffic data (vehicle numbers and speeds) shall be collected by the Contractor and submitted to the Engineer weekly or as otherwise directed.

401.7 PAYMENT: Payment for Portable Radar Speed Display System shall be full compensation for furnishing the equipment and upon completion of use, delivering the equipment to the County warehouse. Contractor will be paid for each unit as follows:

Initial 75% of the unit bid price after delivery to the project site and ready for use.

Remaining 25% of the unit bid price after delivering the equipment in acceptable condition to the County warehouse.

All cost associated with operating, maintaining, and securing the equipment is to be included under the bid item TRAFFIC CONTROL.

Section 415, Flexible Metal Guardrail (Include in projects that require reconstruction of existing guardrail or construction of guardrail from salvaged material. Revised June 1, 2000)

SECTION 415 FLEXIBLE METAL GUARDRAIL

MCDOT Supplement to MAG Uniform Standard Specifications is modified to add:

Section 415.1 Description:

The work shall also consist of reconstructing existing guardrail, or constructing guardrail from salvage, in accordance with the standard details or the details shown on the project plans, and as per the requirements of these specifications.

This item shall also include all the work and materials to delineate guardrail sections being reconstructed, or constructed from salvage. This item shall also include all the work and materials to delineate guardrail sections.

MCDOT Supplement to MAG Uniform Standard Specifications is modified to add:

Section 415.3.6 Construct Guardrail From Salvage:

Salvaged guardrail, guardrail terminals, guardrail transitions, end terminal assemblies and other guardrail systems, shall be constructed at the locations shown on the project plans and in accordance with the provisions specified herein for new guardrail.

If any salvaged materials are deemed by the Engineer, to be unsuitable for reuse, or if the quantities of salvaged materials are insufficient to complete the work, the contractor shall furnish new materials in sufficient quantities to complete the work and the cost of furnishing such materials will be paid for in accordance with the provisions of the project contract.

Where new bolt holes in rail elements are required, the holes shall be made by drilling or punching. Flame-cut bolt holes will not be permitted.

MCDOT Supplement to MAG Uniform Standard Specifications is modified to add:

Section 415.3.7 Reconstruct Guardrail:

Existing guardrail, guardrail terminals, guardrail transitions, anchor assemblies, end terminal assemblies, and other guardrail systems, shall be removed and reconstructed at the locations shown on the project plans, and in accordance with the provisions specified herein for new guardrail.

When reconstruct guardrail is specified, posts shall be completely removed and then reconstructed. When guardrail anchor assemblies are removed, the existing concrete foundation shall be fully removed and the void backfilled with moist soil in compacted lifts, per Section 415.3.2 Roadway Guardrail paragraph 3.

New foundation tubes shall be installed in place of guardrail anchors for all anchor assemblies that are to be reconstructed.

All guardrail components requiring removal shall be removed in such a manner as to prevent damage to and minimize the loss of the components.

If any materials designated for reconstruction are deemed by the Engineer to be unsuitable for reuse or if the quantities of existing materials are insufficient to complete the work, the contractor shall furnish new materials in sufficient quantities to complete the work and the cost of furnishing such materials will be paid for in accordance with the provisions of this contract.

Items designated to be reused, which are lost, damaged or destroyed as a result of the contractor's operations, shall be repaired or replaced by the contractor at no additional cost to the County.

Existing post, blocks, rail elements or hardware which are not required for guardrail reconstruction or which the Engineer deems unsuitable for reconstruction, shall be removed and disposed of as requested by the Engineer.

Where new bolt holes in rail elements are required, the holes shall be made by punching or drilling. Flame-cut bolt holes will not be permitted.

MCDOT Supplement to MAG Uniform Standard Specifications is modified to add.

Section 415.4.5 Constructing Guardrail From Salvage:

Constructing the various types of guardrail from salvage will be measured by the meter (foot) or by the unit each, using the limits of measurement specified for new construction.

MCDOT Supplement to MAG Uniform Standard Specifications is modified to add.

Section 415.4.6 Reconstruction Of Guardrail:

Reconstructing the various types of guardrail will be measured by the meter (foot), or by the unit each, using the limits of measurement specified for new construction.

MCDOT Supplement to MAG Uniform Standard Specifications is modified to add.

Section 415.5.5 Construct From Salvage:

The accepted quantities of construct guardrail from salvage, measured as provided above, will be paid for at the contract unit price, complete in place, including excavation, backfill and disposal of surplus or unusable materials.

The contractor will be paid in accordance with the provisions of the contract for furnishing new posts, blocks, rail elements or hardware to replace components deemed by the Engineer unsuitable for reuse, or to supplement insufficient existing quantities for reconstructing the various types of guardrail from salvage.

MCDOT Supplement to MAG Uniform Standard Specifications is modified to add.

Section 415.5.6 RECONSTRUCT GUARDRAIL:

The accepted quantities of reconstruct guardrail, measured as provided above, will be paid for at the contract unit price, complete in place, including excavation, backfill and disposal of surplus or unusable materials.

The contractor will be paid in accordance with the provisions of the contract for furnishing new posts, blocks, rail elements or hardware to replace components deemed by the Engineer unsuitable for reuse, or to supplement insufficient existing quantities for reconstructing the various types of guardrail from salvage.

Section 420 Chain Link Fence (Include in projects with a bid item for Chain Link Bridge Fence – PER ADOT STD. DWG. B-22.50, 22.60, AND 22.70. Revised June 1, 2000)

Section 420 add the following, specifically for the construction of Chain Link Bridge Fence:

420.1 Description: This work shall consist of the fabrication and installation of Chain Link Bridge Fence, including all accessories, on reinforced concrete bridge decks, curbs, parapets, and barriers, and as required on other concrete structures and structural elements, in conformance with the Specifications, this Supplement, the Construction Special Provisions, and the Project Plans. Details of the Chain Link Bridge

Fence shall generally conform to the appropriate requirements of the current Arizona Department of Transportation (ADOT) Standard Drawings:

- B-22.50 "Pedestrian Fence Details with Curb",
- B-22.60 "Pedestrian Fence Details with Parapet", and/or
- B-22.70 "6'-0" High Fence Details with Parapet or Barrier",

as specified in the Construction Special Provisions or as indicated on the Project Plans.

420.3 Construction:

420.3.1 Fence Construction: Chain Link Bridge Fence shall be fabricated and installed in accordance with Shop Drawings submitted by the Contractor and approved by the Engineer, in accordance with the requirements of Section 105.2. The Contractor shall not initiate fence fabrication until the Shop Drawings are approved.

Expansion Joints in the bottom and intermediate rails shall be spaced at intervals not greater than 40 feet (12 meters), or as detailed on the Project Plans. All expansion joints shall utilize an external pipe/tube sleeve of the same material as the rails; external sleeve size shall be sufficient to permit the expansion joint to function freely. Expansion Joints shall not be installed in the top rail of Chain Link Bridge Fence.

420.4 Measurement: Chain Link Bridge Fence will be measured on the fence line along the bottom rail, from center to center of end posts.

Section 430.5.8 Native Hydro Seeding (Include on all PM 10 projects that require seeding of disturbed areas. Add to the bidding schedule item 430.01201 Native Hydro Seeding with the units of Acres (Ha). Added October 7, 2002)

SECTION 430 LANDSCAPING AND PLANTING

430.5.7 Water Truck Irrigation

Water truck irrigation shall not be used for hydro seeded areas.

430.5.8 Native Hydro Seeding is modified to add the following:

430. 5.8.1 Native Seed Mixture:

The Contractor will be responsible for Hydro seeding all areas disturbed by construction. The seed mixture shall consist of all the listed varieties proportioned to obtain the indicated coverage for each variety. The seed mixture shall be mixed thoroughly and spread evenly throughout the area to be treated. Seed shall be broadcast at the rate shown in the seed mixture table. Seed mixture substitution requests shall comply with Section 430.5.1 Substitutions.

Native Seed Mix for Areas Adjacent to Roadways (Within Designated Clear Zones)			
Common Name	Scientific Name	Pure Live Seed	
		Kilograms Per Hectare	Pounds Per Acre
Brittle Bush	<i>Encelia farinosa</i>	4.5	4.0
Creosote Bush	<i>Larrea tridentata</i>	9.0	8.0
Globe Mallow	<i>Sphaeralcea ambigua</i>	3.4	3.0
Indian Wheat	<i>Plantago insularis</i>	2.2	2.0
Purple Three-Awn	<i>Aristida purpurea</i>	2.2	2.0
Desert Marigold	<i>Baileya multiradiata</i>	1.7	1.5
TOTAL Seed Mixture		23.0	20.5

430. 5.8.2 Seeding Materials and Equipment

Straw mulch shall be used as the primary mulch cover, applied evenly at a rate of 3.4 - 5.6 tonne per hectare (1.5-2.5 tons per acre). Clumps and accumulations of straw must be loosened and evenly spread. It shall be placed within 48 hours of seeding and immediately affixed by crimping and/or tacking. The affixing shall consist of pure mucilage at a rate of 1.7 kg per hectare (150 lbs. per acre) tackifier and 560 kg per hectare (500 lbs. per acre) cellulose fiber.

Straw shall be from oats, rye, wheat, or other grain-type crop. It shall be clean and free from invasive weeds, mold and other objectionable materials. It shall initially be in a dry condition suitable for spreading.

Cellulose fiber mulch @ 220 kg per hectare (200 lbs per acre) for slopes up to 1:3 (Vert:Horz), 670 kg per hectare (600 lbs. per acre) for slopes greater than 1:3, and 1120 kg per hectare (1000 lbs. per acre) for extremely erosive/steep slopes.

Cellulose fiber mulch shall consist of at least 70% specially prepared virgin wood cellulose fiber and processed specifically for use as hydro mulch.

Tackifier/Binder

Pure mucilage tackifier shall be added at 56 kg per hectare (50 lbs. per acre) for slopes up to 1:3 (Vert:Horz), and 90 kg per hectare (80 lbs. per acre) for slopes greater than 1:3.

The Ammonium phosphate (16-20-0) shall be applied at 340 kg per hectare (300 lbs. per acre).

Sections 465.4 and 465.5 Measurement and Payment (Include on projects that install non-illuminated Metro Street Name Signs and the project is to be

advertised prior to July 2005. This revision will be added to the 2005 MCDOT Supplement to MAG. Added 11/3/2004)

SECTION 465 SIGN PANELS:

465.4 Method of Measurement add the following:

Metro Street Name Sign Installation shall be measured by the unit each for every installed and approved Metro Street Name Sign.

465.5 Basis of Payment add the following:

The contract unit price for Metro Street Name Sign Installation shall be full compensation for furnishing all labor, materials, tools, equipment, fastening hardware, all necessary sign support accessories, stringers, post ties and incidentals, and for performing all the work involved in installing the Metro Street Name Sign panels, complete in place, as shown on the plans and as specified.

Section 470.4.1 Quality Requirements (Include on projects that install signal facilities and the project is to be advertised prior to July 2005. This revision will be added to the 2005 MCDOT Supplement to MAG. Added 7/26/2004)

SECTION 470 GENERAL REQUIREMENTS FOR TRAFFIC SIGNAL AND INTERSECTION LIGHTING SYSTEMS:

470.4.1 QUALITY REQUIREMENTS add the following:

Pre-approved items are posted on MCDOT's Procurement website:
<http://www.mcdot.maricopa.gov/procurement/mcdot/aml.pdf>

Section 481.3.1(A) General Requirements (Include on projects that install fiber optic conduits and the project is to be advertised prior to July 2005. This revision will be added to the 2005 MCDOT Supplement to MAG. Added 7/14/2004)

SECTION 481 FIBER OPTIC CONDUIT AND PULL BOXES:

481.3.1(A) General Requirements revise the sixth paragraph to read as follows:

Detectable tape/wire shall be installed in each non-metallic fiber optic multiduct to facilitate locating underground fiber optic cables. One pull tape/rope is **required** in each innerduct.

Section 505.11 Measurement (Include in projects when payment for reinforced concrete box culverts is based on quantities of Concrete and Reinforcing steel. Added August 8, 2002)

SECTION 505 CONCRETE STRUCTURES

505.11 MEASUREMENT:

Add the following:

Cast-in-place reinforced concrete box culverts including wingwalls, aprons, and other integral components will be measured based on the quantity of concrete and reinforcing steel incorporated into the approved structure in compliance with the plans or as directed by the Engineer.

Section 505.6.4 Longitudinal Joints between Precast Bridge Deck Members (Include in projects with longitudinal joints between precast bridge deck members. This section is to be used with section 506.9.1.)
The attached specification has not been reviewed by Mr. Wojakiewicz. Comments and questions are much encouraged.
(June 1, 2000)

SECTION 505 CONCRETE STRUCTURES

Section 505 of the MCDOT Supplement is supplemented with the following:

505.6.4 Longitudinal Joints between Precast Bridge Deck Members is deleted in its entirety. It is replaced with the following new Section in Section 506:

Section 506.9.1 Longitudinal Joints between Precast Bridge Deck Members (Include in projects with longitudinal joints between precast bridge deck members. This section is to be used with section 505.6.4.)
The attached specification has not been reviewed by Mr. Wojakiewicz. Comments and questions are much encouraged.
(June 1, 2000)

SECTION 506 PRECAST PRESTRESSED CONCRETE MEMBERS

Section 506 add the following:

506.9.1 Longitudinal Joints between Precast Bridge Deck Members:

(A) General: All bridge superstructures comprised of longitudinal precast prestressed concrete bridge deck members (box beams, voided slabs, and slab units) with deck overlay wearing surfaces shall be laterally connected with transverse tensioning rod

diaphragm, the member erection and tensioning rod installation shall be done progressively, one member at a time. The installed tension rods shall be tightened to the required final tension; no partial pretightening of the rods will be performed, unless required to eliminate non-uniform member bearing. The Contractor may defer grouting longitudinal shear keys between adjacent members that are fully tensioned transversely (installed without pretightening the tension rods), as approved by the Engineer.

When partial pretightening of the rod(s) is required to attain uniform member bearing, the longitudinal shear key joint shall be grouted immediately after the rod(s) are pretightened. Then, with the acceptance of the grouting by the Engineer, the final transverse tension shall be applied to the rod(s) compressing the joint just grouted, in accordance with the Final tensioning requirements in this Section. All partial pretightening requirements for short transverse rods installed in pairs will require those longitudinal joints to be grouted on a 'one joint at a time basis', and the next deck member in the span then erected.

For spans utilizing short perpendicular tensioning rods in pairs, the Contractor shall adjust transverse tightening and shear key grouting procedures as necessary to achieve 1) the required final transverse tensioning with 2) the uniform bearing of all deck members in the span, as approved by the Engineer.

Final Tensioning: The final tensioning in all transverse tie rod systems (full-length single rods and short rods in pairs) shall be accomplished using the Turn-of-the-Nut Method. Before final tensioning of the rod, the nut shall be loose, and then hand-tightened snugly against the seated anchor plate, and then fully tensioned. Pretightened nuts restraining grouted joints shall be backed off until loose, and immediately snugged by hand and fully tensioned.

Transverse tensioning rod systems will be tightened to develop a tensile force of 30,000 lbs (133.45 kN), unless specified otherwise in the Project Plans or Construction Special Provisions. The number of turns of the nut, required for tensioning each specific rod length, will be specified in the Project Plans or Construction Special Provisions.

(D) Grouting: Grout to be used for packing the longitudinal shear key joints shall be a high early strength prepackaged nonshrink grout or a high early strength sand-cement grout with an expansion agent. The high early strength grout materials; packaging and storage; and grout mixing, surface preparation, and placement shall be in full conformance with the current requirements of Section 1017 – NONSHRINK GROUT MATERIALS of the Arizona Department of Transportation (ADOT) Standard Specifications for Road and Bridge Construction, and shall be a type approved by the Engineer. If the precast deck members were cast with air-entrained concrete, the grout shall use air-entraining Portland cement.

All spaces between deck members at the bottoms of the longitudinal shear keys, where grout could escape, shall be grout-tight before placing the grout. The Contractor shall

use backer rod or other similar systems, as required, to ensure that the grout does not escape during placement, as approved by the Engineer.

The grout shall be placed and tightly packed into the longitudinal shear key joints, in accordance with the manufacturer's recommendations, as approved by the Engineer, completely filling the joints. The exposed surface of the grout shall be struck off even with the tops of the deck members, leaving a uniform surface, which shall be free of holes, pockets, and other surface irregularities.

Immediately after placement is complete, all exposed surfaces of the grout shall be cured by the water method, as specified in Section 505.8 of the MCDOT Supplement, or in accordance with the manufacturer's recommendations, as approved by the Engineer. No loads shall be allowed on tensioned and grouted spans for which the transverse tensioning and grouting has been completed less than 72 hours, unless otherwise permitted by the Engineer.

Section 508, Cattle Guard (Include in projects with cattle guard installations. Revised 12/18/2003)

SECTION 508 CATTLE GUARD

508.1 DESCRIPTION: This work shall consist of furnishing all materials and labor to construct new cattle guards at the locations shown on the plans.

508.2 MATERIALS & CONSTRUCTION: Materials and construction requirements shall be in accordance with the current Arizona Department of Transportation (ADOT) Standard Specifications for Road and Bridge Construction, Section 906 Cattle Guards, the referenced ADOT Standard Drawing, and as modified by these special provisions and the construction drawings.

508.2.1 Cattle guards shall be constructed using beams designed for H-20 or heavier loading.

508.2.2 Precast units may be used when fabricated in accordance with shop drawings submitted by the Contractor and approved by the Engineer. The precast option shall incorporate a proactive design acceptable to the Engineer to ensure the maximum gap space between adjacent grill units will not exceed $\frac{1}{4}$ ".

508.3 MEASUREMENT: Cattle guards shall be measured as complete units in place for each size structure constructed. The size of cattle guards shall be noted by the number of grill units used in the installation.

508.4 PAYMENT: Payment for cattle guards constructed and accepted will be made at the contract unit price bid for each structure, complete in place.

Section 516, Irrigation and Drainage Grates (Include in projects with Irrigation or Drainage Gates, the specific gate requirements are to be inserted. Revised July 11, 2001)

SECTION 516 IRRIGATION AND DRAINAGE GATES

The work under this Section consists of furnishing and installing irrigation and drainage gates at the locations shown on Plans and in accordance with the manufacturer's requirements.

The Contractor shall submit to the Engineer at the pre-construction conference manufacturer data sheets for each type of gate proposed for use on the project. The manufacturer data sheets shall include product specifications and installation requirements.

[INSERT SPECIFIC GATE REQUIREMENTS HERE. The following is an example used in previous special provisions.

Drainage (Flap) gates shall be Waterman Model F-10, Type SF Off Vertical Closure, or approved equal.]

Payment for all work under this section will be made at the unit price bid for each size and type of Irrigation or drainage gate furnished and installed, complete in place.

Section 523 Headwall (Include in projects with a bid item for headwall. Revised January 24, 2003)

Part 500 add the following new Section:

SECTION 523 HEADWALL

The work under this section shall consist of constructing headwalls of the types and at the locations shown on the Plans.

Concrete block masonry shall conform to Section 510 and concrete structures shall conform to Section 505.

(Optional Paragraph – delete if not applicable) The work under this Section shall also consist of plaster ditch connections between headwalls and ditches if specified on the Plans. Locations and dimensions shall be as shown on the Plans. Plaster ditch connections are to be included in the bid item for the headwall.

(Pick Measurement & Payment method – delete if not applicable) Measurement for headwalls will be by the square meter (square foot). The surface area measured shall

be the product of the wall length times the height of the wall (exposed face) above the footing, excluding the area of the pipe opening.

Payment will be made at the contract unit bid price per square meter (square foot) for Headwall.

(Pick Measurement & Payment method – delete if not applicable) Headwalls will be measured by the number of each type of headwall constructed and accepted.

Payment will be made at the contract unit price bid for each Headwall of the designated type(s).

Section 525 Pneumatically Placed Mortar (Include in projects with a bid item for pneumatically placed mortar used for canal lining. Adjust lining structural section when appropriate. Revised November 5, 2001)

SECTION 525 PNEUMATICALLY PLACED MORTAR

Section 525 add the following:

Canal lining shall be 80 millimeter (3 inches) thick, hand placed concrete (Class A), or 50 millimeter (2 inches) thick, pneumatically placed mortar, both reinforced with welded wire fabric, 6x6, 1.4/1.4. Lining shall be tied to existing lining.

Section 530, Painting (Include when the project includes a bid item for concrete painting. Revised April 1, 1999)

SECTION 530 PAINTING

Section 530 add the following:

The work under this Section consists of painting the concrete surfaces of the bridge as indicated below:

1. Top surface and both faces of concrete bridge railing and railing ending section.
2. Bridge fascia from top of railing base to bottom of deck slab and underside of deck slab for width of bridge.
3. Face of abutments and slope walls to 300 millimeters (12") below top of riprap or ground.
4. Pier columns from bottom of deck slab to top of drilled shaft.

Surfaces to be painted do not require a plaster coating as part of the finishing process.

The paint shall be Sher-Clad Exterior Acrylic Latex Flat, B2Y Series Paint as manufactured by the Sherwin-Williams Company of Cleveland, Ohio, or approved equal.

Application of the paint shall be in accordance with the manufacturer's written recommendations.

The color of the paint shall be sand color, subject to approval of the Engineer.

Construction Requirements: The paint shall be applied by an Arizona Licensed Painting Contractor, that is acceptable to the manufacturer and the Engineer.

The Contractor shall prepare a preliminary sample of the bridge and railing paints, each, on concrete slabs at the work site, measuring at least one meter (3 feet) by three meters (10 feet), that shall be left for three weeks for observation.

No paint shall be applied on the project until the samples have been approved by the Engineer.

Payment for all work under this Section will be made at the bid price for Concrete Painting.

Section 610 Waterline Construction (Include in projects when ductile iron pipe is required. This GSP requires review and modification prior to use. Revised April 1, 1999)

SECTION 610 WATERLINE CONSTRUCTION

The work under this section consists of furnishing and installing the water lines and support system as shown on the plans.

All water line construction shall conform to the requirements of Section 610. In addition, all components of the water line shall be installed in accordance with the manufacturer's recommendations.

Pipe shall be ductile iron, thickness Class 53 per Section 750.2. Pipe shall be cement mortar lined and coal tar coated in accordance with AWWA C-104. Fittings shall be per Section 750.4. Pipe shall be a restrained push-on rubber gasket joint pipe and joints shall be US Pipe TR Flex Restrained Joint or approved equal.

A combination air release/vacuum relief valve shall be provided at the highest point of the water line. The valve shall be a combination air release/vacuum valve with a minimum orifice size of 6.4 mm (1/4 inch). An expansion joint shall be provided at each side of the relief valve. Air release/vacuum relief valve shall be APCO Series 140 or approved equal. Expansion joints shall be restrained Dresser, Style 63, Type 3 or approved equal.

Drain valves shall be installed at the lowest point of the pipe at each end. After completion of all testing and disinfection procedures in accordance with Section 610 and 611 of the Uniform Standard Specifications, all water shall be drained from the lines and all valves shall be closed. Compressed air shall be used as necessary to insure that all moisture is removed from the lines.

Payment for all work under this section will be made at the bid price per meter (linear foot) for Ductile Iron Pipe, and at the unit bid price for Air/Vacuum Relief Valve, Complete In Place.

Section 615 Sewer Line Construction (Include in projects requiring ductile iron pipe for sewer line construction. Revised April 1, 1999)

SECTION 615 SEWER LINE CONSTRUCTION

The work under this section consists of furnishing and installing the sewer lines and support system as shown on the plans.

All sewer line construction shall conform to the requirements of Section 615 of the Uniform Standard Specifications and these Construction Specifications. In addition, all components of the sewer line shall be installed in accordance with the manufacturer's recommendations.

Pipe shall be ductile iron, thickness class 53 per Section 750.2. Pipe shall be cement mortar lined and coal tar coated in accordance with AWWA C-104. Fittings shall be per Section 750.4. Pipe shall be a restrained push-on rubber gasket joint pipe and joints shall be US Pipe TR Flex Restrained Joint or approved equal.

A combination air release/vacuum relief valve shall be provided at the highest point of the sewer line. The valve shall be a combination air release/vacuum valve with a minimum orifice size of 4.8 mm (3/8 inch). An expansion joint shall be provided at each side of the relief valve.

Air release/vacuum relief valve shall be APCO Series 400 SAVV or approved equal.

Expansion joints shall be restrained Dresser, Style 63, Type 3, 380 mm (15 inches) minimum movement rating, or approved equal.

Pipe installed 30.5 meters (100 feet) minimum on each side of the air/vacuum relief valve shall be polyethylene lined with a nominal thickness of 40 mil conforming to ANSI and ASTM D-1248.

Payment for all work under this section will be made at the price bid per meter (linear foot) for Ductile Iron Pipe, Lined Ductile Iron Pipe, unit bid price for Air/Vacuum Relief Valve, Complete In Place.

Section 622 Pipe Culvert (Include when pipe culvert material is to be determined by the contractor. The Contractor may choose to use reinforced concrete, HDPE pipe, or corrugated metal pipe. Revised March 13, 2002)

Part 600 add the following new Section:

SECTION 622 PIPE CULVERT

622.1 Description: The work under this section consists of furnishing and installing pipe culvert, including connections and flared end sections where indicated.

622.2 Material: The Contractor may furnish Reinforced Concrete Pipe, High Density Polyethylene (HDPE) Pipe, or Corrugated Metal Pipe. Reinforced Concrete Pipe shall be Class III, Rubber Gasket, conforming to the requirements of Section 735. HDPE pipe shall be corrugated pipe conforming to AASHTO M 294M and the requirements of Section 738. Corrugated metal pipe shall conform to the requirements of AASHTO M-36 and Sections 621 and 760. Corrugated metal pipe shall have a minimum wall thickness of 2.01 mm (14 gauge) and be bituminous coated or bituminous coated and paved. When flared end sections are indicated, corrugated metal pipe and HDPE pipe shall use metal flared end sections conforming to ADOT standard Drawing C-13.25, reinforced concrete pipe shall use concrete flared end sections conforming to MAG Detail 545.

622.3 Installation: Installation of reinforced concrete pipe and HDPE pipe shall conform to Section 618. Installation of corrugated metal pipe shall conform to Section 621.

622.4 Measurement: Measurement of Pipe Culvert will be the number of meters (feet) of pipe, measured to the nearest (foot) tenth of a meter along the pipe centerline, from end to end of the pipe through manholes and specials. At changes in diameter the measurement will be to the center of manhole or special. Measurement for Flared End Section will be by the unit each for the various sizes of pipe culvert.

622.5 Payment: Payment for Pipe Culvert will be made at the unit bid price for each size culvert installed, complete in place. Payment for Flared End Section will be at the contract unit price bid for each end section installed, complete in place.

Section 624 Temporary Pipe Culvert Installation (Use when pipe culverts are required for a designed detour. Allows contractor to provide alternative pipe material and sizes, to obtain a minimum hydraulic capacity. The Contractor may choose to use reinforced concrete, HDPE pipe, or corrugated metal pipe. The plans should identify the installation as TEMPORARY PIPE CULVERT, give the hydraulic parameters and an acceptable alternative. Revised November 7, 2001)

Part 600 add the following new Section:

SECTION 624 TEMPORARY PIPE CULVERT INSTALLATION

624.1 Description: The work under this section consists of furnishing, installing, and removing temporary pipe culvert, including pipe connectors to provide cross drainage for the detour road.

The contractor may submit for approval proposed alternative Temporary Pipe Culvert installations together with hydraulic calculations that show the proposed installation will provide a safe installation with hydraulic capacity equivalent or greater than the installation shown on the plans.

624.2 Materials: The Contractor may furnish Reinforced Concrete Pipe, High Density Polyethylene (HDPE) Pipe, or Corrugated Metal Pipe. The pipe strength shall be suitable for the proposed installation without special traffic load restrictions. Reinforced Concrete Pipe shall be Class III (minimum), Rubber Gasket, conforming to the requirements of Section 735. HDPE pipe shall conform to the requirements of Section 738. Corrugated metal pipe shall conform to the requirements of AASHTO M-36 and Sections 621 and 760. Corrugated metal pipe shall have a minimum wall thickness of 0.079 inches (14 gauge). The pipe may be either new or used. All material shall be in serviceable condition without discernable flaws.

624.3 Installation: Installation of reinforced concrete pipe and HDPE pipe shall conform to Section 618. Installation of corrugated metal pipe shall conform to Section 621.

624.4 Measurement and Payment: Payment for Temporary Pipe Culvert Installation will be made at the lump sum price bid and shall include all labor, materials, and equipment for both the installation and removal of the culvert installation.

Section 625 Manhole Construction And Drop Sewer Connections (Use when Pollutant Separator Vaults are part of the storm drain system and detailed in the project plans. Revised July 31, 2001)

SECTION 625 MANHOLE CONSTRUCTION AND DROP SEWER CONNECTIONS

Section 625 add the following:

625.1.3 Pollutant Separator Vaults: Construction shall consist of furnishing all materials and constructing the Pollutant Separator Vaults complete in place as detailed including all appurtenant accessories such as but not limited to interior piping, pipe supports and braces, access shafts and covers, and any incidentals thereto.

625.2 Materials: Concrete for Pollutant Separator Vaults shall be Class A and shall conform to the requirements of Section 725. Reinforcing steel shall conform to the

requirements of Section 727. Masonry materials shall conform to the requirements of Sections 775 and 776. All other materials shall be as noted.

625.3.3 Construction: Concrete construction shall be in accordance with Section 505. Structures may be furnished as precast structures, in accordance with the requirements of Section 505.1.1.

Excavation and backfill shall be in accordance with the requirements of Section 206.

Pollutant Separator Vault access shafts, frames, covers, and steps shall be in accordance with the requirements of Section 625.3.1.

625.4 Measurement: Measurement for Pollutant Separator Vaults will be by the unit each. This measurement by the unit each shall include all appurtenant accessories such as but not limited to frames, covers, interior piping, access shafts, and incidentals thereto.

625.5 Payment: Payment for Pollutant Separator Vaults will be made for each accepted unit, at the Contract Unit Price. Payment will be full compensation for each item, Complete-in-Place, including necessary excavation, materials, construction, fabrication, installation, backfilling, and appurtenant accessories and incidentals, as described on the Project Plans and in these Special Provisions.

Section 626 Miscellaneous Structures (Roadway Drainage And Irrigation) (Include in projects only if directed. This is a draft specification to allow all minor and miscellaneous concrete structures to be precast and the specification will need substantial modification. Revised June 1, 2000)

SECTION 626 MISCELLANEOUS STRUCTURES (ROADWAY DRAINAGE AND IRRIGATION)

626.1 Description: Work under this Section consists of constructing miscellaneous reinforced concrete roadway drainage and irrigation structures, at the locations and in accordance with the details shown on the project plans, and in conformance with these Specifications. Typical Miscellaneous Structures include but are not limited to headwalls, standpipes, junction boxes, catch basins, manhole shafts, delivery structures, headgates, turnouts, etc.

626.2 Materials: Concrete shall be Class AA or Class A, as indicated on the Project Plans, in the project Construction Special Provisions, or in the MAG Standard Details, and shall conform to the requirements of Section 725. Reinforcing steel shall conform to the requirements of Section 727. Masonry materials shall conform to the requirements of Sections 775 and 776. All other materials shall conform to the call-outs on the Project Plans, to the project Construction Special Provisions, to the MAG Standard Details, and/or to appropriate Part 700 materials specifications.

626.3 Construction: Concrete construction shall be in accordance with the requirements of Section 505. Unless specified otherwise in the project Construction Special Provisions, all Miscellaneous Structures defined in Section 626.1 are Minor Structures as defined in Section 505.1, and may be furnished as precast structures, in accordance with the requirements of that section and these Specifications.

Excavation and backfill for Miscellaneous Structures shall be in accordance with the requirements of Section 206.

626.4 Measurement: Measurement for this work will be by specific pay item quantities, or by the unit each, as specified in the contract documents. Measurement by the unit each for Miscellaneous Structures shall include all appurtenant accessories such as but not limited to frames, grates, covers, gates, trash racks, etc.

626.5 Payment: Payment for this work will be made at the contract unit price(s) per specific pay item quantities, or per the unit each. When the measurement is by the unit each, payment will be full compensation for the item, complete in place, including necessary excavation, materials, construction, fabrication and installation, backfilling, and appurtenant accessories, as described on the project plans and in these Specifications.

Section 636 Concrete Canal Lining (Include in projects with concrete lined canals use section 635 for smaller irrigation ditches.

The specification was developed around SRP requirements, including fiber-reinforced concrete, but based on the MAG Specifications.

3/29/2004)

SECTION 636 IRRIGATION CANAL LINING

636.1 Description: Work under this Section consists of constructing cast-in-place concrete or pneumatically placed mortar (shotcrete) canal lining in conformance with the details shown on the project plans, the applicable provisions of Sections 505 and 525, and these Specifications.

636.2 Materials: Concrete for cast-in-place concrete canal lining construction shall be air-entrained Class A Portland cement concrete conforming to the requirements of Section 725.

Pneumatically Placed Mortar (shotcrete) for canal lining construction shall conform to the requirements of Section 525.3 – Wet Process. Aggregate Gradation No. 2 shall be used for canal linings not thicker than 3 inches (76 millimeters), Aggregate Gradation No. 3 may be used for canal linings thicker than 3 inches (76 millimeters), or the Contractor may use an aggregate gradation as approved by the Engineer.

All concrete for the canal lining, whether cast-in-place or pneumatically placed, shall have fibrous reinforcement incorporated into the concrete mix. The application rate for the fibrous reinforcement shall be 1.5 lbs/cu yd (0.89 kg/m³). The fibrous reinforcement shall have the following characteristics:

- a) Specific Gravity = 0.91
- b) Tensile strength = 379 MPa (55 ksi)
- c) Fiber Length Graded = 6 to 15 millimeters (1/4 to 5/8 inches)

The fibrous reinforcement shall produce fiber-reinforced concrete and fiber-reinforced shotcrete that complies with the current version of ASTM C 1116, Section 4 – Classification, 4.1.3 – Type III Synthetic Fiber-Reinforced Concrete or Shotcrete. Documented performance of the fiber-reinforced concrete and fiber-reinforced shotcrete shall comply with Performance Level I, as specified in Section 21 – Performance Requirements, of the current version of ASTM C 1116.

Reinforcement for Concrete Canal Lining shall be 102 x 102 – MW9.1 x MW9.1 (4 x 4 – W1.4 x W1.4) welded wire fabric conforming to the material requirements of AASHTO M 55/M 55 (ASTM A 185), unless specified otherwise in the contract documents. All welded wire fabric shall be galvanized in accordance with ASTM A 641/A 641M, “regular coating”.

All appurtenant accessories for Concrete Canal Lining shall meet the specification requirements of the contract documents.

636.3 Construction:

636.3.1 Subgrade: Subgrade for the Concrete Canal Lining shall be shaped and compacted in accordance with the requirements of Section 215, except that all shaped subgrade surfaces shall be compacted to 85 percent uniform density. Finished surfaces shall be uniform planes and/or uniformly varying transitions as required by the project plans, and shall be free of large rocks, voids, and loose material. Subgrade tolerances shall be in conformance with Section 505.10.1(F) of the MCDOT Supplement, or as approved by the Engineer.

The canal bank and bottom lining subgrade surfaces shall be maintained in a moist condition, within 2 percent of the optimum moisture content, at all times prior to the installation of the concrete canal lining, to provide dust abatement and prevent premature drying and cracking of the concrete canal lining upon installation.

636.3.2 Reinforcing Steel: The width of fabric rolls shall be not less than 5 feet (1.5 meters). J-hook fabric pins shall be fabricated from 9-gage (3.76 millimeters diameter) or larger wire and provide adequate strength and anchorage to secure the wire mesh fabric, as approved by the Engineer.

The welded wire fabric shall be clean prior to placement, and shall be maintained in a clean condition until completely embedded in the lining concrete. Welded wire fabric shall not be installed until the Engineer has approved the area of canal subgrade over which the fabric is to be placed. The welded wire fabric shall be installed longitudinally to the canal; all fabric shall be cut and fit as required for the fabric to be placed flat, without bulging. All laps/joints shall be lapped not less than one mesh width, and laps at the roll ends shall be staggered. J-hook pins shall be spaced to anchor the welded wire fabric, and to prevent displacement of the installed fabric during concrete placement, as approved by the Engineer. Climbing on the canal bank subgrade and the welded wire fabric placed on the canal bank will not be permitted.

636.3.3 Concrete Canal Lining: The Contractor shall use concrete conforming to the requirements of Section 636.2 for the canal lining. Either cast-in-place concrete or pneumatically placed mortar (shotcrete) shall be used for the canal bottom lining; pneumatically placed mortar (shotcrete) shall be used for the canal bank lining.

The Contractor shall not place canal lining concrete for the canal bottom and the canal bank, respectively, until the Engineer has approved the respective canal subgrade preparations and reinforcement installations. All absorptive surfaces against which concrete will be placed shall be pre-moistened in conformance with the requirements of Section 636.3.1 of this Section, but no concrete shall be placed on subgrade having free water on the surface.

The thickness of the concrete canal lining shall be as detailed on the plans; the minus thickness tolerance shall be zero. The positive thickness tolerance for the canal bottom lining shall be that required to meet canal profile grade; the finished grade of the concrete bottom lining shall be within 0.1 foot (30 millimeters) of the plan elevations, or as approved by the Engineer. The positive thickness tolerance for the canal bank lining is nominal. Overall dimensional tolerances for the completed canal complex, encompassing lining and appurtenant features, shall be consistent with the project contract documents.

Placed concrete shall be compacted/vibrated by suitable means, as approved by the Engineer. All construction joints between the new canal lining and the existing canal lining and/or new and existing appurtenant features shall conform to the details on the project plans. The finished surface of the concrete canal lining shall be even and uniform, without rock pockets and surface voids, and free from ridges and other projections. The finish of the concrete canal bottom shall be skid resistant; the concrete canal bank lining shall have a uniform broom finish.

The finished concrete shall be cured by the use of a white-pigmented membrane-forming compound conforming to the requirements of Section 726.

636.4 Measurement: Measurement for Irrigation Canal Lining will be by the square yard (meter) of concrete lining surfacing constructed as detailed on the project plans and accepted by the Engineer. Only new exterior surfaces shall be measured.

636.5 Payment: Payment for Irrigation Canal Lining will be made at the contract unit price per square yard (meter) for concrete canal lining. Payment shall be full compensation for concrete lining, complete in place, including all labor, materials, and equipment.